Transportation Library

SEP 8 1958
UNIVERSITY OF MICHIGAN
SEP 8 1958
TRANSPORTATION LIBRARY

The Dock & Harbour Authority

No. 454. Vol. XXXIX. AUGUST, 1958 Monthly 2s. 6d.

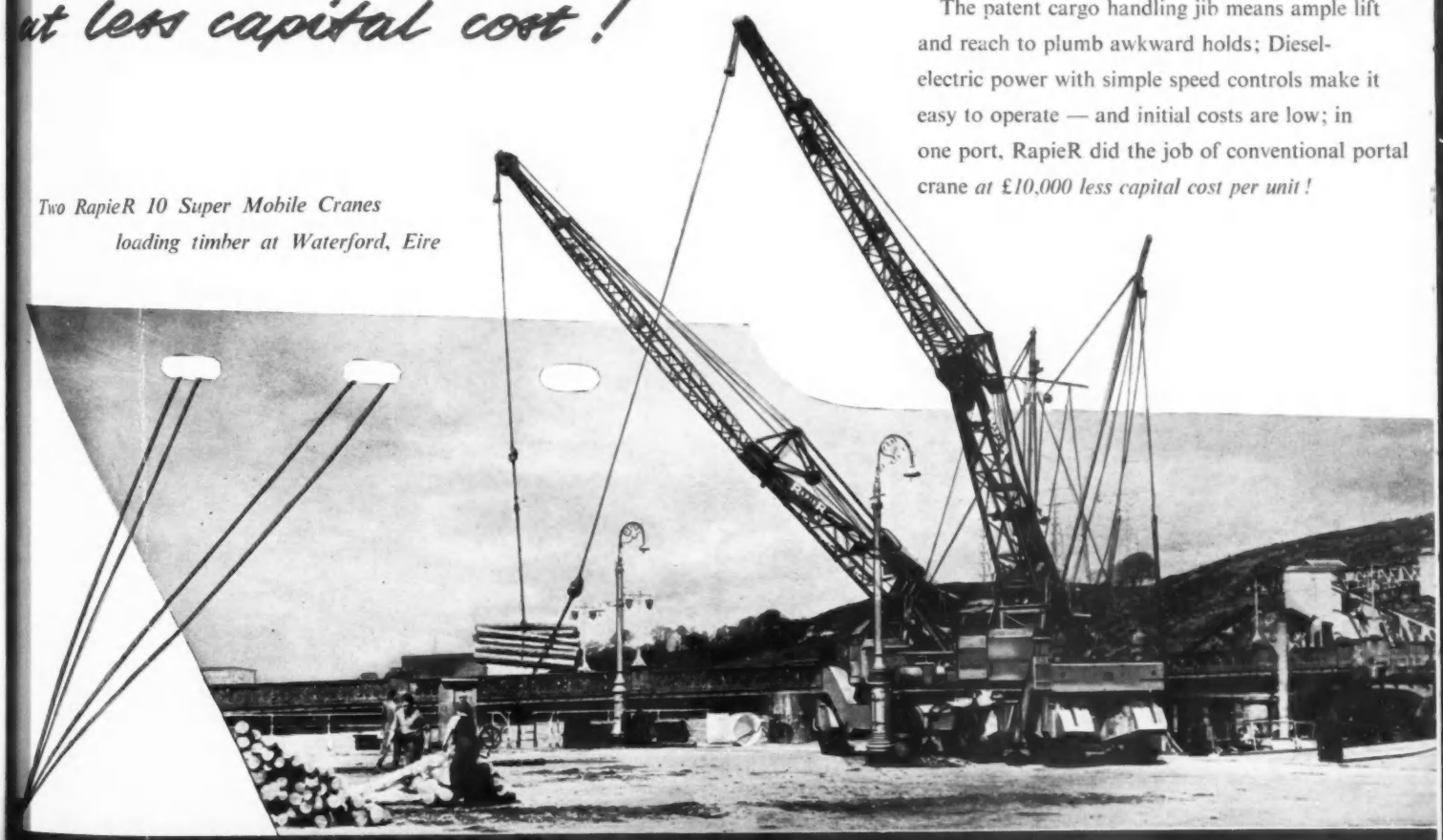
RAPIER

10 SUPER MOBILE
THE IDEAL SHIPSIDE CRANE
at less capital cost!

Less expensive installation, complete mobility and the power to tackle the toughest jobs — no wonder so many of the world's ports choose RapieR Mobile Cranes.

The patent cargo handling jib means ample lift and reach to plumb awkward holds; Diesel-electric power with simple speed controls make it easy to operate — and initial costs are low; in one port, RapieR did the job of conventional portal crane *at £10,000 less capital cost per unit!*

Two RapieR 10 Super Mobile Cranes loading timber at Waterford, Eire



RAPIER

MOBILE CRANES
Three years guarantee
against mechanical breakdown

RANSOMES & RAPIER LTD. IPSWICH ENGLAND

With the Priestman System, dredging can proceed unhindered by a heavy swell with waves 8′-9′ high

PRIESTMAN

PRIESTMAN BROTHERS LIMITED, HEDON ROAD, HULL, ENGLAND
BCA

The Dock & Harbour Authority

An International Journal with a circulation extending to 85 Maritime Countries

No. 454

Vol. XXXIX

AUGUST, 1958

Monthly 2s. 6d.

Editorial Notes

Mersey Docks and Harbour Board Centenary

The first meeting of the Mersey Docks and Harbour Board was held on January 5th, 1858, and this year the Board are celebrating their Centenary. The Port of Liverpool has been fortunate in having men of foresight and courage to direct its policy and the record of their achievement is one of almost continuous development and progress. Tonnages of both ships and cargo using the port have shown a steady upward trend and the figures during the twelve months ending 30th June, 1958, reached an all-time record. The total net tonnage of shipping entering the river was 27,495,336, and the tonnage of vessels entering the docks was 18,936,395—also a record. Both sets of tonnages showed an increase of over 900,000 tons on the previous year.

It is true that the traffic of the port is largely the regular cargo liner services which are not much affected by general shipping and world trade conditions and, also, that there is a trend towards ships of larger tonnage using the port. Nevertheless, Liverpool is maintaining and improving its position as a dry cargo port and the work which is now proceeding on the construction of a large tanker terminal at Tranmere will make it in the near future one of the world's most important oil ports.

We are publishing in this issue an article which has been specially contributed by Mr. A. S. Mountfield, General Manager and Secretary to the Board. In this, attention is drawn to the main improvements which have been carried out in the past year or are projected in the future. It should not be overlooked, however, that apart from the administration of the dock estate and facilities related to the handling of cargo, the Board are also responsible for the conservancy work of the port. They own a large fleet of vessels used for pilotage, dredging, salvage work, lighting, buoying and surveying. Since the Second World War this fleet has been augmented by two new pilot boats, a survey tender and launch, two salvage and conservancy vessels, five grab hopper dredgers, one bucket ladder dredger and a tug. A third pilot boat is soon to be delivered.

Another important scheme undertaken by the Board has been the construction of training walls on both sides of the main channel in Liverpool Bay to improve the tidal scour. This work has been in progress for 40 years and is soon to be completed.

On all sides the picture is one of activity and expansion and with the opening of the St. Lawrence Seaway next year, the port will be in a favourable position to attract further trade.

The Liverpool Steam Ship Owners' Association

Another important centenary to be celebrated in the Port of Liverpool this year is that of the Liverpool Steam Ship Owners' Association, which held its first meeting in December, 1858. It was formed to protect and advance the common interests of proprietors of shipping in the Port and the problems with which it was confronted were, in the main, much the same as they are in 1958. From time to time, however, new factors such as "flags of convenience," air competition and the growth of State-aided foreign competition, have to be seriously considered.

The successful growth of the Association can be gauged by the tonnage figures. At its inception, the amount of inaugural tonnage was 70,000 gross tons represented by six members; on January 1st, 1958, there were 67 members with a gross tonnage of 4,556,321. There has always been a close link between the Association and the Mersey Docks and Harbour Board, partly because they both came into existence in the same year and partly because they have many interests in common. Of the 24 elected members of the Board, by practice 12 represent the ships and 12 the cargoes. The Association is concerned with the nomination of 10 of those representing the ships and an election on the basis of retirement by rotation takes place once a year in December.

British Inland Waterways Inquiry

The Committee of Inquiry, "The Bowes Committee," set up in February, 1956, has published its report, summarised on a later page. The Committee was presented with a formidable task and clearly has spared no effort in evaluating the difficult problems involved. It had to prepare recommendations upon the future and the maximum economic use of the country's system of waterways for commercial transport and for other purposes, as well as upon the disposal of waterways no longer useful for their original purpose.

There have been many expert investigations in the past, the recommendations of which have largely been ignored. The most recent was the Board of Survey, convened by the British Transport Commission itself; this necessarily was confined to the Commission's waterways and was undeservedly stigmatised in certain quarters as an unduly cautious condonation of the Commission's past policies. The Commission, obliged as it is by statute to operate remuneratively could hardly be expected to advocate policies which certainly would lead to an increased deficit. The latest report is therefore welcome since, from an independent standpoint, it advocates certain changes which will be welcomed by all concerned with the industry.

Some principles of outstanding importance must be mentioned; firstly that to encourage confidence in canal transport, especially on those marginal waterways at present active but known to be unprofitable, an undertaking should be given to reinstate them to their original standard and so to maintain them for at least 25 years; secondly to abandon the toll system on these waterways, and to replace this with an annual licence, a procedure designed to increase productivity, similar to Continental practice and frequently advocated in these columns; thirdly that a Government subsidy should provide for the nett revenue loss thereby arising; fourthly that new legislation should provide procedure for redevelopment or elimination of waterways no longer valuable for transport.

The Committee's classification of waterways and associated recommendations are also of interest, particularly since their evaluation is so nearly identical with that of the previous Board of Survey. In Class A are 380 miles of waterway currently earning, as a whole, £300,000. It is recommended that this should be ploughed back to provide improvements and on no account diverted to meet deficits elsewhere. Three waterways did not appear in Group 1 of the Board of Survey Report, including the River Witham and the Fossdyke Canal, notorious because their apparent working deficit arises from annuity payments debited to them but which should surely be charged to railway accounts.

In Class B are 935 miles of marginal waterways, recommended for re-instatement and a guaranteed life. Although proposed measures may arrest or even reverse the downward trend in

Editorial Notes—continued

traffics, there seems little chance that their receipts will suffice to meet charges in the foreseeable future. Classes A and B form the "Prescribed Navigable System"; Class C comprises the remainder.

Although the Committee is fully agreed on future measures, there is divergence on the question of the bodies to implement these. We hope that the Government will not delay its acceptance of the proposals on the grounds of this lack of unanimity, which is a matter of relative detail. We also hope that it will not be tempted to introduce within the present British Waterways organisation any needless upheaval.

An Apologia for Flags of Convenience

On a following page in this issue is given a full summary of the case recently made for "flags of convenience" by Mr. Erling D. Naess, who operates a tanker fleet under the Liberian flag. Many people will regard his contribution to the controversy as a piece of special pleading. Mr. Naess would have the strange emblems which fly at the masthead of many American ships called "flags of necessity," but it is strange that a country which boasts in one breath that it has the highest standard of living in the world should in the next plead that because of high operating costs (a natural corollary) it cannot afford a merchant fleet except by resorting to stratagem. There is no international bar at which shipowners who register ships under other than the national flag can be arrainged, but a policy of expediency rather than principle can cause America's friends some uncomfortable moments.

Mr. Naess told his London audience that whatever steps are taken in America to enable its shipping industry to survive are strongly criticised by European interests. He listed some of these steps—subsidies, the 50 per cent. rule, the use of flags of "necessity" and the reservation of the coastal trade to United States ships. It is curious that it should not have occurred to him that every one of these measures offends against the spirit of private enterprise, of which the United States professes to be the champion; and that every one of them contains an element of discrimination which is the antithesis of the freedom of the seas.

Much as they dislike subsidies, it is safe to assume that British shipowners would prefer to see the American mercantile marine supported by open State subventions than by the adoption of the flag of a country which could not by any standard be regarded as a maritime nation.

On one important question of fact a little more clarity is necessary. Mr. Naess says that earnings of American-owned shipping companies in Liberia and Panama are not taxed in the United States until earnings are remitted to the United States and that the position is identical to that of British shipowners establishing companies in Bermuda. But it is identical in only that one particular. British shipowners if they went to Bermuda would continue to register their ships in the United Kingdom; they would continue to be governed by the provisions of the Merchant Shipping Act in every respect; and they would continue to be subject to United Kingdom law. Above all, they would not be sailing under false, or at any rate, artificial colours.

Small Ships and Dock Facilities

In the annual report of the British Motor and Sailing Ship Owners' Association it is stated that major factors in rendering the cost of coastwise movement uncompetitive are the excessively high level of cargo handling charges in the ports, and slow rate of turn-round. These factors are largely outside the shipowners' control, but to an increasing extent their ships can only compete with rail or road where they can load or discharge at senders' or receivers' own waterside premises. If port employers, whether they be private wharfingers or public port authorities, and dock labour can devise some means of reducing these terminal costs and of increasing the speed of loading and discharging, they would immediately improve the prospects of the coasting trade and incidentally their own volume of employment.

Last year's annual report drew attention to the unsatisfactory features, from the shipowners' point of view, of the charges scheme promoted by the British Transport Commission. Accordingly, further discussions were initiated by the Traders' Dock and Harbour Co-ordinating Committee, on behalf of shipowners and traders, with the Commission, which resulted in the latter promoting an agreed new scheme. This came into operation on June 1, 1958, and confers a headroom of 25 per cent. over existing statutory dues on ships and goods. The Commission has given an assurance that before exercising its new charging powers there will be appropriate consultation with users.

To meet rising costs the authorities at the following ports had to increase their charges—Inverness, Milford Docks, Penryn, River Cart, Sunderland and Tyne. An examination of the financial position of all undertakings concerned showed that their proposals were justified and no objections were raised.

Although representations were made to the Commissioners of Customs and Excise that the trade of the Port of Truro was likely to revive, the Customs House there was closed in July, 1956. During the past twelve months there has been a decided improvement in the foreign trade of the port and in consequence the question of the future of the Customs House is being reconsidered. Proposals to close Customs Houses at, or to remove waterguard offices from, the small ports of Arbroath, Brightlingsea, Keadby, Neyland and Seaham have received attention.

New Lock for Hungarian Inland Waterways

With the completion of a new lock at Tiszalök in north-eastern Hungary, a further 62 miles of the River Tisza has been opened to navigation, enabling shipping to travel north of the Tiszalök dam to within ten miles of the Hungarian-Soviet frontier, and right up to it during the summer months. The completion of the lock is another step in Hungary's long-term programme for improving her waterway system by linking the main rivers and the 48-mile long Lake Balaton. It will also ensure that shipping from Szolnok, eighty miles to the south can use the river throughout the year.

The difference in water levels at the dam is 24-ft., and the new lock, which is hydraulically operated, is 81 metres long and 17 metres wide. A ship can pass through it in ten to fifteen minutes.

The next stage in the navigation improvement plan will comprise the construction of a lock at Tiszabura, north of Szolnok, to form a "step" to Tiszalök and to keep more water in the upper reaches of the river. This will make the River Bodrog, a Tisza tributary above the Tiszalök, navigable from Tokay for about thirty miles to the Soviet frontier.

Extensions to the Port of St. John's, Newfoundland

Early this year it was announced that the Department of Public Works, Newfoundland, is to undertake the development of the Port of St. John's at an estimated cost of over $12,000,000. Provision will be made in the Department's estimates for 1958/59 so that the acquisition of property, demolition work, etc., may be started without delay. The proposed development includes the construction of a large modern terminal wharf, complete with extensive handling and storage facilities; a marginal wharf for coastal shipping; the provision of additional access roads to relieve traffic congestion, and many other improvements.

In addition to this programme, the Department of Transport will undertake the construction of a new Marine Agency, including wharf and buildings which is expected to take between two and three years to complete.

The initial development is part of a master plan for future harbour expansion which will remove the many obstacles now hampering the activities of the port. It is estimated that, at the present rate of shipping turnover, these improvements will lead to an annual saving of approximately $1,000,000 through a general speed-up of loading and unloading operations and a quicker turn-round of ocean-going vessels. These savings should be increased by a continuation of the present economic trend, resulting in further expansion of the harbour's activity.

The rapid growth of the population of Newfoundland and the resulting increase in development of natural resources and industries have convinced the Federal Government of the necessity for improving the existing harbour of St. John's to meet the growing requirements of the import and export trade.

Mersey Docks and Harbour Board Centenary

Enterprising Development of Port of Liverpool

By A. S. MOUNTFIELD
(General Manager and Secretary)

THIS year the Liverpool Port Authority, the Mersey Docks and Harbour Board, celebrates its Centenary for it was constituted by Parliament in 1857. Its responsibility was the harbourage, conservancy and allied arts of the Mersey and its sea approaches, and the control of the long line of docks at Liverpool and the smaller area at Birkenhead. Down the centuries the Mersey's commerce with the high seas had been increasingly entrusted to corporate bodies: in 1710, for example, it was first vested in the town council, and in 1811 in an elected committee. But before 1858, as a royal commission reported, it was clear that not only a new approach but a new constitution was needed, to meet the demands of the future.

The approach was that of a public trust. The constitution was one which, in its essentials, was to be copied not only by other dock, conservancy and transport boards, but in time by such unexpected creations as the B.B.C. The Mersey Docks and Harbour Board was, indeed, the first expression of that typically British creation, a trust which is neither nationalised, subsidised, nor profit-making.

So the newly-created Board took over all the assets—and liabilities—of the previous authority. It had as chairman, Charles Turner, chairman of the old committee. Its members were described at the time as being "the foremost and the pick" of Liverpool's public men, noted for their success in business and their ability as administrators.

The formation of the Board—which held its first meeting on 5th January, 1858—ended the question of the right of the Corporation to charge town dues, which had been a perennial subject of argument. But this was as nothing compared with some of the other problems the Board had to face. Outstanding, was that of increasing dock accommodation, for in the preceding twenty-five years, the Mersey's tonnage had grown from 1,540,057 to 4,645,362 tons. Steamships of greater length and draught were rapidly replacing sailing ships, and the quantities of cargo were increasing accordingly. Many shipowners and traders were agitating for more accommodation for their ships and goods. The Canadian timber trade, for example, had so increased that the Brunswick Dock had become completely inadequate and vessels were being delayed for an average of thirty days before entering the dock.

Another matter for concern was the depth of water at the entrances. Vessels drawing only nineteen feet were unable to dock immediately they arrived, and those drawing twenty-four feet could enter only on very few days in the year. During the first six months of 1857, 112 vessels had been held up in the river through lack of sufficient depth of water, and 225 delayed through shortage of berthing space. It was obvious that vast extensions to the dock system had to be carried out quickly, and so plans were prepared for new works.

From some quarters there was persistent agitation that the work which had already begun at Birkenhead across the river should be completed before anything was done on the Liverpool side. It was contended that the completion of the western system would soon yield a good financial return for the capital expenditure. Many, however, opposed this proposal; one objector likened the Birkenhead docks to "a shop on the wrong side of the street." Yet another question was the provision of warehouses, for the prevalent practice was to leave cargo on open quays, which caused congestion and slowed down work.

These were but a few of the problems confronting the new Board. During the first six months, indeed, its meetings were long and sometimes bitter, and from three to six columns were devoted to them in local papers.

But the Board cut its teeth successfully, largely due to the fact that it had been constituted mainly from shipowners and merchants and in the years which followed they were succeeded by men whose background and experience enabled them to continue the administration of the port in accordance with the high standard which the original Board established.

At this time the Liverpool shore of the harbour was already a sizeable port, for its docks extended from Huskisson in the north to Toxteth in the south, with a total water area of 207 acres. (At Birkenhead only the Morpeth and Egerton docks, with an area of a mere seven acres, had been completed). But it began its history in the spirit which was to characterise all its works—a spirit of investment, enterprise and development.

The first work undertaken on the Liverpool side was the construction of the Canada, Herculaneum and Waterloo docks. At Birkenhead, Morpeth was extended and other docks built. But despite all this work the growth of trade soon made further extensions necessary, and so in 1871 the dock engineer was directed by the Board "to consider and report as to the capabilities of the Mersey Dock Estate in its present condition to meet the probable requirements of the great and increasing commerce of the port and as to the alterations or additions which might be requisite for that purpose, or which might appear to be called for on a comprehensive view of the general policy of the Trust."

The engineer had confidence in his river and his proposals were ambitious, their cost being estimated at four million pounds. Sanctioned by Parliament in 1873, they covered the construction of five new docks and extensions to two existing ones as well as building a boundary wall round the estate. But even as work was in progress on these important additions, the increasing beam and draught of new vessels called for the provision of yet more accommodation.

So in 1898—only twenty-five years later—Parliament's permission was sought for further improvements at the north end and for the re-modelling of the southern system, the estimated cost being over £3,500,000. New branches and more deep water quayage were provided and two graving docks built. Finally, much widening and deepening of existing docks was carried out.

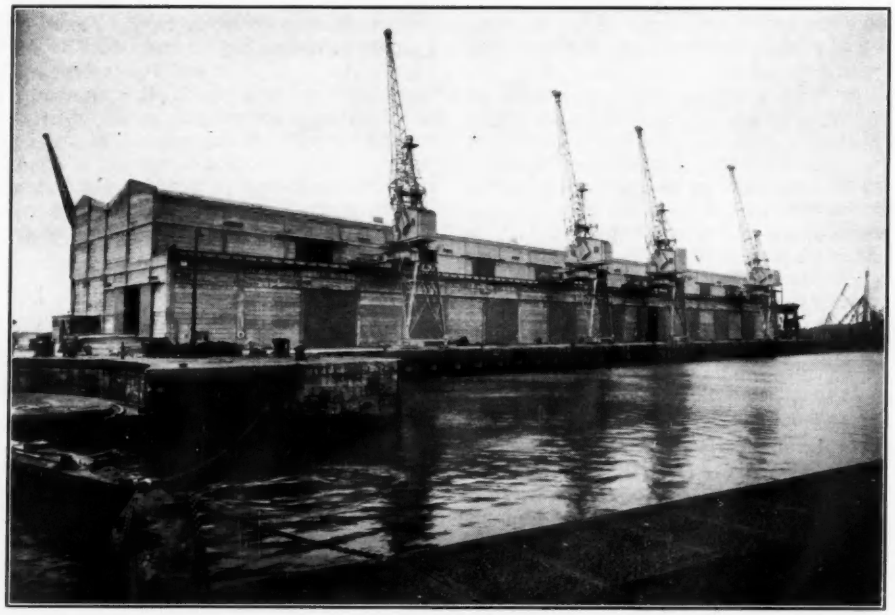
The new century brought still further improvements, though this time they were on dry land rather than the water. In 1900 the Georges dock was drained, and on its site began the erection of the three great buildings which have come to symbolise Merseyside, the offices of the Royal Liver Friendly Society, of the Cunard Steam Ship Company Ltd. and of the Dock Board itself.

Then the work of major construction reached its peak with the building of the Gladstone system of docks. Parliamentary powers for this were obtained in 1906, but the work was delayed owing to a depression in shipping at this time. Eventually work began in 1910 at the Gladstone Graving Dock, which was completed three years later. The dock remains one of the largest in Europe, being 1,050-ft. long with an entrance 120-ft. wide.

The First World War froze the scheme until 1921, and the Gladstone system was indeed not completed until the eve of the depression in 1927. In a sense this year marked the end of an era of new construction. But much remained to be done by way of modernisation. Apart from the war years this has been a continuous operation and a detailed description of the many facets of post war modernisation was given by my predecessor in this Journal in April, 1957.

Since that time the steady progress has continued and the first unit of the £17,000,000 reconstruction scheme at the Canada and Langton docks has been brought into commission. This is one of the three sections of the new double storey transit shed at the West side of the Canada dock. It is 525-ft. long, 120-ft. wide with a quay margin of 36-ft. and served by 4 three

Mersey Docks—continued



Southern portion of new shed, West Side, Canada Dock.

ton and 1 five ton quay cranes. The first ship commenced discharge there on the 20th May, 1957. She was the Harrison Line vessel "Journalist" from Galveston with 1,672 tons of cotton, mohair, etc., and completed 3 days later. Up to the end of the year 24 other ocean going vessels discharged at the berth and one loaded. Over 80,000 tons of cargo carried by them have passed through the shed in just over seven months. The whole scheme, when completed, will provide six more berths of this type and the part they will play in solving the port's berthing problems can be well gauged by the results achieved at the first section now in commission.

Another satisfactory feature of the reconstruction scheme has been the completion of the engineering work in connection with the widening of the passage between the Canada and Brocklebank Docks. This passage was originally 80-ft. wide but has now been reconstructed with a width of 130-ft. to correspond with the new entrance and has a sill level to give 40-ft. of water. This has in itself been a major engineering operation for most of the work had to be carried out under the cover of temporary dams and two important town sewers had to be extended for a distance of about 1,100-ft. to the new river wall.

Caisson for Canada-Brocklebank Passage

The passage is closed by a caisson the main dimensions of which are: overall length of hull, 133-ft. 6-in.; width overall, 31-ft. 9-in.; depth from top of side plating to sill, 45-ft.; and weight, 1,200 tons of steelwork and timber and 500 tons of cast iron ballast. The caisson slides in a grooved way 32-ft. wide, giving a sideways clearance of 3-in.

There are four decks, which function as girders on their sides; the ribs are spaced fairly closely and serve to carry the skin plating and to support the decks.

The weight of the caisson is taken on a pair of steel runners on the bottom which slides over a slide-way of polished granite stones. In order to minimise the pull necessary to set the caisson in motion, a buoyancy tank, or air chamber, is provided at a sufficiently low level so that it is always submerged; it serves to reduce the pressure on the slides to the least amount consistent with steadiness when the caisson is acted upon by waves.

The air chamber is subdivided into compartments by watertight bulkheads to restrict possible flooding, and consequent loss of buoyancy, should an accident occur which resulted in holing.

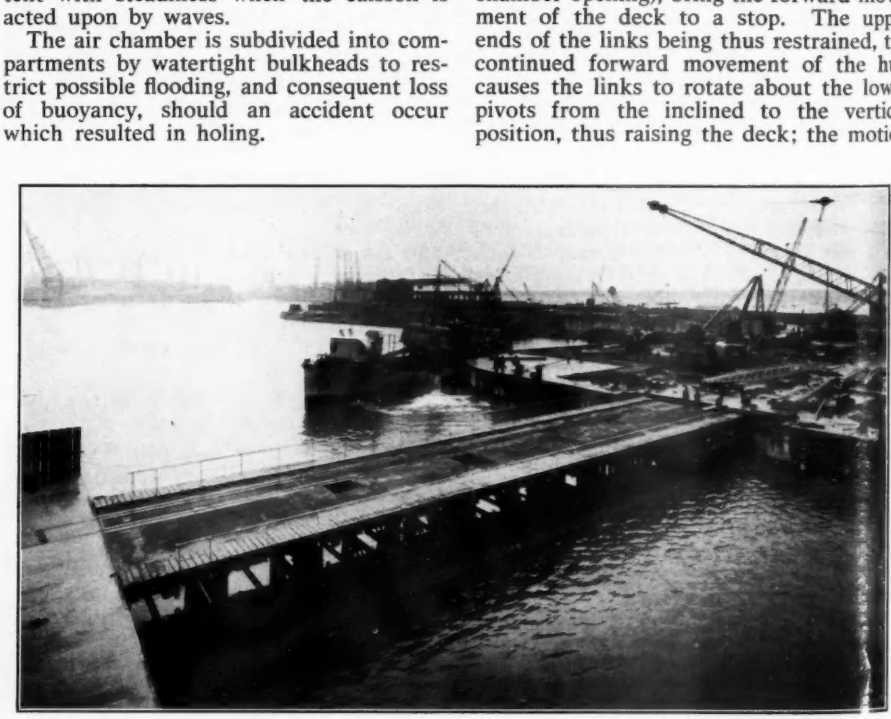
The caisson can be floated in and out of its position in the passage for dry-docking, etc. It is for this purpose that the cast-iron ballast is provided, as otherwise, the caisson would be top heavy when floating.

As the caisson is 3-ft. 6-in. longer than the width of the passage, and the coping bridges over the opening in the passage wall formed by the caisson chamber, it is necessary to make a strip of this bridge-coping portable, so that the caisson can be floated upwards to clear the sills and be manoeuvred out of the chamber. With only three inches sideways clearance, the caisson would jam when being swung out of the chamber. To overcome this, a short detachable length is provided in the greenheart sill timber, which, on removal, reduces the width of the caisson sufficiently to allow it to swing clear.

A most interesting feature of the caisson is the falling deck which carries the roadway and rail track across the passage, thus saving the expense of a separate bridge.

The road and railway are continued along the roof of the caisson chamber, and, in order to make it possible to withdraw the caisson into the chamber, the falling deck has to drop 4-ft. 6-in. vertically.

The falling deck is supported on a series of rocking links pivoted to the hull of the caisson. When the deck is up, the links are perpendicular: when it is down, they are inclined. At the top end of each link is another pivot, which carries the girderwork of the deck. Projecting from the forward end of the deck girders are two arms carrying striking rollers, which on coming into contact with vertical striking plates set in the nose-end recess (i.e. opposite the chamber opening), bring the forward movement of the deck to a stop. The upper ends of the links being thus restrained, the continued forward movement of the hull causes the links to rotate about the lower pivots from the inclined to the vertical position, thus raising the deck; the motion



No. 1 Caisson in position. Canada-Brocklebank Passage.

Mersey Docks—continued

is assisted by counterweights. In practice, the lower end of the striking plate is curved upwards in such a manner as to reduce the shock of initial impact.

The operating machinery is electrically powered. There is a two-speed gear change to cater for the increased hauling load required when the water level in the docks is abnormally low and there is a greater pressure on the slides resulting from the loss of buoyancy due to the uncovering of steelwork previously submerged.

Normal operation is by one or other of two completely independent electrical power units, either of which is capable of hauling the caisson. The caisson will travel at approximately 36 or 24-ft. per minute.

The electric motors drive a series of large gear wheels, which in turn drive endless chains working in recesses down either side of the caisson chamber. A girder spans across the chamber between these chains and moves with them. To the centre of this girder is connected the apex of a triangular frame attached to the after end of the caisson, close to the top of the plating. Thus, according to which way the chain is driven, the caisson is either pushed out across the passage or pulled back into the chamber.

Bulk Sugar Handling Installation

Reference was also made in last year's article to the extensions which were at that time being made by Tate & Lyle Ltd., to their bulk sugar handling installation at the North side, Huskisson Branch Dock No. 3. This project, which has now been completed, was brought into full operation at the beginning of this year and I am indebted to Messrs. Tate & Lyle Ltd. for the following details.

The installation consists of two adjacent berths which can both accommodate vessels carrying a burthen of up to 10,000 tons of bulk raw sugar. Both are equipped with four cranes carrying grabs. The eight cranes discharge on to two lines of belt conveyors, running the full length of the quay.

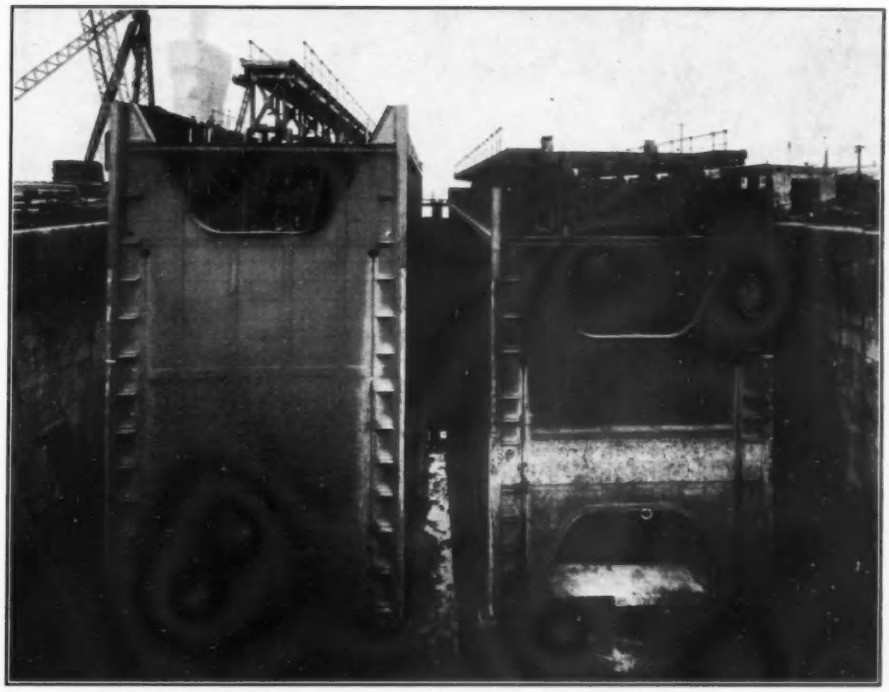
The four cranes on the middle berth are 5 ton single rope cargo cranes, fitted with automatic grabs. Each crane has a mobile hopper located behind it and running on rails. The crane grab discharges its sugar into the hopper and a band conveyor fixed below the hopper transfers the sugar on to the quay conveyor.

The four cranes on the middle quay were originally installed on the East berth and landed their sugar into 25 ton hoppers. Road vehicles ran below the hoppers for loading, and then removed the sugar to the Refinery. This scheme started the landing of bulk raw sugar in Liverpool in 1952, and has satisfactorily bridged the gap between the commencement of this new method of handling and the execution of the comprehensive project.

The cranes now installed on the east berth are new multi-rope 5 ton grabbing cranes of the "kangaroo" type. These cranes have a hopper built into the front of the crane itself, which enables the crane driver to lift a grab of sugar and drop it in the opening immediately beneath him, in much the same manner as a kangaroo has access to its pouch. This produces a simpler and faster operation, as it reduces the need for slewing.

The combined unloading capacity of the new cranes on the east berth is some 600 tons per hour, whilst those on the middle berth can achieve 340 tons per hour.

Each cargo must be kept separate until samples have been drawn, and both the landed weight of the cargo, and weight of the sugar delivered direct to the Refinery have been determined. To achieve this, the sugar delivered from each ship is carried on separate quayside conveyors to the end of the east berth. At this point it is transferred to the conveyors which run up the inclined gantry, across the Dock Road, and up to the top of the weigher tower.



View of completed caissons. No. 1 (on right) for Canada-Brocklebank Passage. No. 2 (on left) for New River Entrance Lock.

The weigher tower is of brick construction with a steel frame; it is 120-ft. in height and rests on piled foundations. The external walls are built in 11-in. cavity brick work and the steel work is surrounded by not less than 2-in. of concrete. At the top of the weigher tower the raw sugar falls into the weighing machine hoppers, each cargo being kept separate. Before this point, however, samples have been drawn by the Sugar Association of Lancashire for analysis.

From the hoppers the raw sugar is weighed in Servo Balans weighing machines operated by the Master Porter. There are three of these machines, each capable of weighing 400 tons of raw sugar per hour in 15,000 lb. lots. Arrangements are such that one or two weighers can be allocated to either berth, depending on the rate of discharge of the vessel at that berth. Provision is made for the installation of a fourth machine.

The purchase price of raw sugar, and the duty payable, are related to the quality as determined by analysis, and the landed weight. Correct sampling and weighing are therefore of the utmost importance to the refiner, the seller, and H.M. Customs, and this most vital aspect of raw sugar landing is adequately taken care of by the facilities provided. The landed weights, as determined by the Master Porter, are also used to ascertain the dues payable to the Mersey Docks and Harbour Board on the cargo.

The controls and dials of the weighing machines are situated in a room isolated from the general space.

Immediately above the weigh office, and with a direct intercommunicating stairway, is the main control panel for the whole conveyor system. From this point most of the installation can be viewed through easily accessible windows, and a small manual telephone exchange communicates with the eight crane drivers and with other key points of the system.

After weighing, the raw sugar is conveyed through a gantry, which rises to the top of the vehicle filling tower, each cargo still being separate.

The vehicle filling tower is a steel framed structure straddling two road weighbridges and a brick built weighing office. The upper part of the tower forms the transfer station

Mersey Docks—continued

Huskisson Dock: Aerial view showing the two unloading berths and storage silo for bulk sugar handling.

between conveyors leading from the bottom of the weigher tower, and those leading to the shuttle conveyors in the top of the silo. Contained within the tower are two 130 ton hoppers, each of which is located above a road weighbridge. The landed raw sugar may be discharged in total or in part into one or other of these hoppers for loading into road vehicles, or again, in total or in part, it can pass to two further conveyors leading to the top of the bulk storage silo.

The conveyors leading to the silo run in a gantry, which also provides access to inspection platforms situated high up on the gable end within the silo, and from which the pile may be viewed for control purposes.

Raw sugar intended for direct delivery to the refinery is gravity fed from the appropriate vehicle filling hopper into the waiting vehicle as it stands on the road weighbridge. The weight of raw sugar removed from this point is thus easily ascertained, and, as the landed weight of that particular cargo has been determined in the weigher tower, the quantity of sugar put into the silo is known by difference.

The weighing office houses the two weighbridge dials, from which the weights are called out for entry on to the various documents relating to the removal of raw sugar.

In designing the arrangements for the filling of vehicles from the hoppers, it was necessary to provide for the following types:—

(1) Tractor/trailer units carrying two specially designed boxes as used at present.

(2) Rigid eight-wheel vehicles carrying two specially designed boxes mounted on the chassis.

(3) Vehicles as yet to be developed, but designed to give a better pay load per unit cost both in initial capital outlay and in running expenses.

The storage silo is among the largest of its type yet built. Its construction is parabolic in shape, the width being 166-ft. at the base with a height to the apex of 86-ft. It is 543-ft. in length. The shell is of concrete and was cast in 12 sections.

The silo, with its floor slab, stands on 460 concrete piles. The whole structure is reinforced with steel, and during construction of the 12 arch sections, the floor, and the two gable ends, 700 tons of steel bar and 105 miles of high tensile steel wire were fixed, and then encased by 18,000 tons of concrete.

The silo will hold about 100,000 tons of raw sugar in bulk. There is a housing on the top for two lines of band conveyors which receive the sugar to be stored, these, in turn, feed two reversible shuttle conveyors. This arrangement enables sugar to be dropped into the silo at any point throughout its length, and thus form the pile. This pile grows in width at its base until restrained by the lower walls of the silo itself. At this point the walls of the silo have been designed to withstand the thrust imposed by the sugar pile. Following this, the sugar takes up its natural angle of repose, resulting in the face of the pile remaining clear of the walls of the silo over the upper part of its contour.

Raw sugar is reclaimed from the bottom of the silo by a band conveyor located in a tunnel beneath the floor. An open trench in the floor of the silo, running along the centre line above the tunnel, allows sugar to fall into louvred hoppers, and the fall out from these hoppers can be regulated by the louvres to give the desired feed on to the band conveyor at each point. About half the sugar will fall by gravity into these hoppers and thence on to the conveyor. The remainder will be moved to the central trench by mobile equipment.

From the silo tunnel, the raw sugar is conveyed by an inclined band which rejoins the main conveyors just below the Servo Balans Weighers. The reclaimed raw sugar is put on to one of the conveyor bands, and carried into one of the hoppers in the vehicle filling tower. From here it is loaded, weighed, and despatched to the Refinery.

The conveyor system provides a separate path from each berth right through to the top of the silo. The necessity for maintaining the discharge of vessels with some degree of plant breakdown has been envisaged, and catered for where possible.

There is only a single conveyor system for reclaiming from the silo, as in the event of a breakdown on this system, raw sugar for the Refinery would be found from other sources pending the completion of repairs.

All conveyors consist of rubber and canvas belts driven at one end. The speed of the conveyor drum at the far end from the drive is compared by electrical means with the speed of the driven end, so that any slip between the driving pulley and the belt is shown up at once on the control panel. A slip of this nature causes accelerated wear of the conveyor belt.

The total length of belting used in the conveyor system is $1\frac{3}{4}$ miles and in order to get as much life as possible from this expensive installation, all conveyors are fitted with variable speed drives so that they need not be run faster than required to handle the sugar at the rate at which the cranes are discharging the ship.

The controls for setting up the conveyor speeds are all carried back to a central panel in the weigher tower, sited just above the Servo Balans machines and an elaborate intercommunication system is also provided.

Throughout the installation every precaution has been taken to prevent spillage. Raw sugar is expensive, so it is essential in the interests of all parties that all is weighed and nothing wasted.

It is necessary for supervisory staff to make frequent tours of inspection whilst raw sugar is being landed and weighed, and the arduous nature of a tour around the system without mechanical aid can well be imagined. To assist those charged with operating the installation a passenger lift runs the full height of the weigher tower. From here the various routes can be followed with little necessity for climbing.

Mersey Docks—continued

Tranmere Development Project

And so these modern facilities have been added to those which have become permanent features in the Port throughout the years, but development cannot stand still and the new century opens with the undertaking by the Board and the Shell Refining Co. Ltd. of a major project for the handling of supertankers at Tranmere on the Cheshire side of the River Mersey, nine miles north-west of Stanlow Oil Refinery.

The rapid growth in the size of these vessels in recent years has created problems for oil companies and port authorities alike. In anticipation of this continued growth, the Mersey Docks and Harbour Board sought and obtained Parliamentary powers to provide facilities for accommodating these large tankers in the area under their jurisdiction.

The Tranmere scheme incorporates the construction of two large floating stages, adjacent to Cammell Laird's shipbuilding yards, each stage capable of accommodating a fully loaded supertanker of up to 65,000 deadweight tons, and even larger vessels on a restricted draft.

Each of the two fully floating stages will be 362-ft. long and 60-ft. wide, with a timber deck supported on steelwork. To enable supertankers of 700-ft. or more overall length to be safely secured, special floating mooring dolphins will be provided ahead and astern of each stage. These dolphins incorporate some new and ingenious features (for which patent applications are pending), and will result in a considerable saving in construction costs as compared with one long continuous stage. The whole scheme is designed to allow for the large tidal rise and fall (over 30-ft.) of the Mersey.

Access to the two-berth oil stage will be by a forked approach jetty carrying roadway, footway and pipelines ranging from 16-in. to 30-in. in diameter, in addition to sundry light, power and telephone cables.

The oil stage will remain the property of the Mersey Docks and Harbour Board, while all the oil lines will be owned by Shell. The oil will be pumped by ship pumps through pipelines into balance tanks on the reclaimed land nearby, then by shore pumps to Stanlow Refinery. Simultaneous discharge of two supertankers of up to 65,000 deadweight tons will be possible, enabling about 150,000 tons of oil to be discharged daily.

Careful preliminary dredging tests have been made to check that no difficult silting problems are likely to arise. Work has now begun, the main contractors for the approach jetty and stages being Peter Lind & Co. Ltd., with the Cleveland Bridge and Engineering Co. Ltd. as sub-contractors for steelwork. The extensive dredging and rock breaking work is being carried out by the Westminster Dredging Co. Ltd.

In full operation the new Tranmere project will be capable of handling, if required, up to 8 million tons of crude oil per annum for Stanlow Refinery.

Mechanical Handling In Ship's Holds

New Methods To Expedite Turn-Round

By W. H. LAIT, M.Inst.T.

The quick turn-round of a ship is dependent on a number of factors. Many of these are extraneous to port working which forms only part of the throughout movement of cargo from factory to consumer. For a ship to work smoothly without interruption, it must have an adequate flow of wharf, road and rail traffic, deliveries timed with her requirements and stowage plan, with no bottlenecks set up by any of the varied services relevant to complete throughput.

The actual function of the ship's discharge or loading can, broadly speaking, be broken down into three stages, each dependent on the other:

(1) The breakdown of the stowage and slinging in the hold for discharge.

(2) Receiving and storing in shed, lighter, railway truck, or lorry.

(3) The cargo capacity of each item in 2 above, and the rate of delivery.

These three stages refer to the operation of discharge but they can be similarly applied to loading. If the quickest turn-round is to be obtained then these three operations must essentially work in harmony.

To illustrate this, it is useless for the hatch to be waiting for the wharf, or the wharf for the hatch, and naturally the ideal state is for one to finish with a sling of cargo at the precise moment the other is ready with the next and not to see hooks waiting to be fed, or the wharf cluttered with goods awaiting attention.

When considering the introduction of materials handling equipment to facilitate the working of a ship, the natural tendency is to apply it to the wharf apron and sheds. Here, generally speaking, wharf, shed and road surfaces are reasonably good, with ample space for travel and manœuvrability. It can offer a quicker working rate and economy of shed space by higher stacking of packages and unit loads thus making fuller use of storage capacity.

It is when the mechanical handling of unit loads is applied to the operations of shipping and discharging (i.e. unstacking in shed and conveying to ship's side for shipment, or breaking down stowage in the hold for discharge, receiving and storing) that equal attention should be given to the stevedore's work in the hold as to that in the sheds and wharf. Otherwise it may well be that the faster operation is impeded by the slower. It serves no purpose to strengthen one link of a chain without giving equal service to the others.

The ship's hold does not offer the same fluid movement to materials handling equipment as does the wharf and shed; there are obstacles such as hatch combings, restricted ceiling height, interrupted travel surfaces even when the skin of the deck is available, and also restricted manœuvrability, particularly as stowage progresses. The stowage plan can create a deterrent, when the cargo is made up by a considerable number of port marks, and maximum discharging facilities are required at ports of discharge.

The above is not written as a deterrent but it is as well to appreciate the possible difficulties. The use of materials handling equipment in ships' holds is very gradually gaining favour and indeed when regarded in its proper perspective it is the common sense method to adopt.

In simple terms, the operation of working cargo in a ship's hold consists of removing a sling of cargo from the square of the hatch to the place of stowage, or breaking down the stowage and making up slings, preferably in the square, for discharge. When these operations are carried out by manual labour, difficulties immediately occur; transport to and from the ends and wings for heavy or unwieldy packages must be carried out by drag, the roller crowbar system or some other device, and when tiering is required which naturally limits the ceiling to a smaller degree,

Fork-lift trucks stowing packs of tinplate along the tween deck.

Mechanical Handling in Ship's Holds—continued

Crated car parts weighing approximately 3 tons being stacked in the lower hold of the "Kenilworth Castle."

the operation is sometimes rendered impossible, with resultant broken stowage, particularly when suitable filler cargo is not available.

For quite a considerable time the use of mechanical aids in ships has been, in the main, restricted to comparatively small ships, and there is little doubt that the exponents of this method of working have been and are still the Scandinavian countries. The writer has visited Norway, Sweden and Denmark within recent months and witnessed the use of side ports by driving fork lift trucks straight on board on to an escalator which conveys the unit load to the desired deck, where stowage is completed by a pallet or fork lift truck. It is a proved fact that, by the combined use of mechanical trucks on wharf and on board, the turn-round of ships has been considerably expedited, and with short voyages where, say, three ships were necessary to maintain the run, two ships now suffice. Such a large percentage of saving could not of course be shown with ocean going ships plying on long voyages, but nevertheless a proportional reduction could be shown which would give a saving approximate to coastal or small ships.

Many types of materials handling equipment suitable for working in ships' holds are now available, such as pallet trucks and fork lift trucks which give maximum lift to the overall closed height of the mast assembly etc. and which, with the many attachments now available offer ample facilities for alleviating the shortcomings of many ships' holds. It can now be reasonably assumed therefore that the number of operations where mechanical aid is not practicable is very small. As mentioned above, the advantages are enormous, elimination of dragging by manual labour, quicker transport to and from the particular point of stowage, easier and safer tiering, and the maximum use of valuable tonnage space.

Pallet truck working in hold of vessel discharging bagged cargo.

Interesting and successful experiments have recently been completed with fork lift trucks working within the lower hold of a ship stowing and tiering cased vehicles. These were handled with ease by an 8,000 lb. capacity truck, which provides an increased load centre for packages of large dimensions and weight, thus giving a much faster working rate per gang per hour with minimum broken stowage. Another operation was the stowage of a shipment of packs of tin plates to the required heights, which when completed formed a suitable floor with adequate head room for the stowage of motor cars. These are only two instances of successfully applied mechanisation, but there are many others.

From a shipping company's point of view, turn-round means the time it takes to make a complete voyage, comprising both time at sea and time in port. The former obviously depends on speed, and particularly since the last war, ships have been built to travel faster; yet the time spent in port averages a longer period that that of pre war. Remembering that ships operate at tariff rates, i.e., the same earning per ton, whether the turn-round—the completed voyage—is completed in say 60 days, or 80 days, it is surely only sensible to examine every possibility that will shorten the turn-round time.

Moving palletised cargo to the plumb of the hatch for discharge. Note the use of expendable pallets.

Finally, mechanical handling of goods may offer advantage when considering the relation of the ship's bale capacity to deadweight—that is how to achieve the shipowner's ambition of being consistently full-down.

Pre-Cooling Sheds in Table Bay Harbour

Steady progress is being made with the rebuilding of the pre-cooling sheds in Table Bay harbour, which were gutted by fire in early January this year. The restoration work will cost over £4,000,000 and it is hoped that the main shed at D berth, which will cost over £2,000,000 and will be able to handle 7,700 tons of fruit, will be commissioned by the end of this year.

A further 4,800 tons of fruit will be dealt with in the large shed which is replacing the sheds destroyed by fire at B and C Berths. The first section of this is expected to be in use by January next and the other section later in 1959.

In the new installations, there will be five pre-cooling sections in all, which will be linked by overhead gantries. The system of dispersing the fruit will be more flexible than that previously in use, and elaborate fire precautions are being installed. When completed, these sheds together with the other facilities in the docks, will enable 16,000 tons of fruit to be pre-cooled.

The Delta Plan: Holland's Great Programme of Sea Defence Works

By C. V. AMERONGEN, M.Sc. (Delft), A.M.I.C.E.

Introduction

ABOUT one-half of the area of the Netherlands is below sea level. This region, which would be inundated at high tide if there were no dykes to protect it, has a population of some six million (out of a total of ten million) and contains nearly all the major towns, including Amsterdam, The Hague and Rotterdam.

The country's North Sea coastline (Fig. 1a) is formed by a chain of islands in the north, an intermediate section consisting of an almost continuous barrier of sand dunes stretching from Den Helder to Hook of Holland, and a southern portion comprising a group of islands separated by tidal estuaries which penetrate deep inland and form, together with a number of lesser waterways, the complex delta of the rivers Rhine, Maas (Meuse) and Scheldt.

In the central region the dunes constitute an effective natural defence against the inroads of the sea. On the other hand, the extreme north of the country (the coastline of the provinces of Friesland and Groningen) and the delta islands in the south-west are protected by dykes. There are over a thousand miles of dykes that have to be maintained in a state of constant readiness.

A major step towards shortening the line of defence was achieved in the years between the two world wars with the construction of a massive dam across the mouth of the Zuyder Zee, thus transforming it into a lake (Yssel Lake). In the south-west, however, the sea continued to have free access to the estuaries, and each of the many islands in this region had to rely on its own encircling dykes for protection.

On the 1st February 1953 an exceptional high tide raised by a storm caused the level of the sea in the south-west part of the country to rise to a height of 0.70 m. above the highest previously recorded level. The dykes of the islands were breached in 67 places, with the result that 150,000 hectares (370,000 acres) of land were flooded, 1,800 people lost their lives, and damage estimated at between £150 and £200 million was caused.

Even before the occurrence of this disaster various schemes for improving the sea defences of south-west Holland had been under consideration. The risk of major inundations had been estimated on the basis of a theoretical "super-storm"—caused by a rare conjunction of unfavourable circumstances—in which the water level at Hook of Holland would rise to 4 m. above mean sea level. It was reckoned that the occurrence of such conditions was governed by a probability of about once in three centuries. In the storm of the 1st February 1953 the water level actually rose to within a few inches of this estimated "super-storm" level. This disconcerting fact led to a revision of existing views on what constituted a reasonably safe maximum, and a figure of 5 m. above mean sea level was

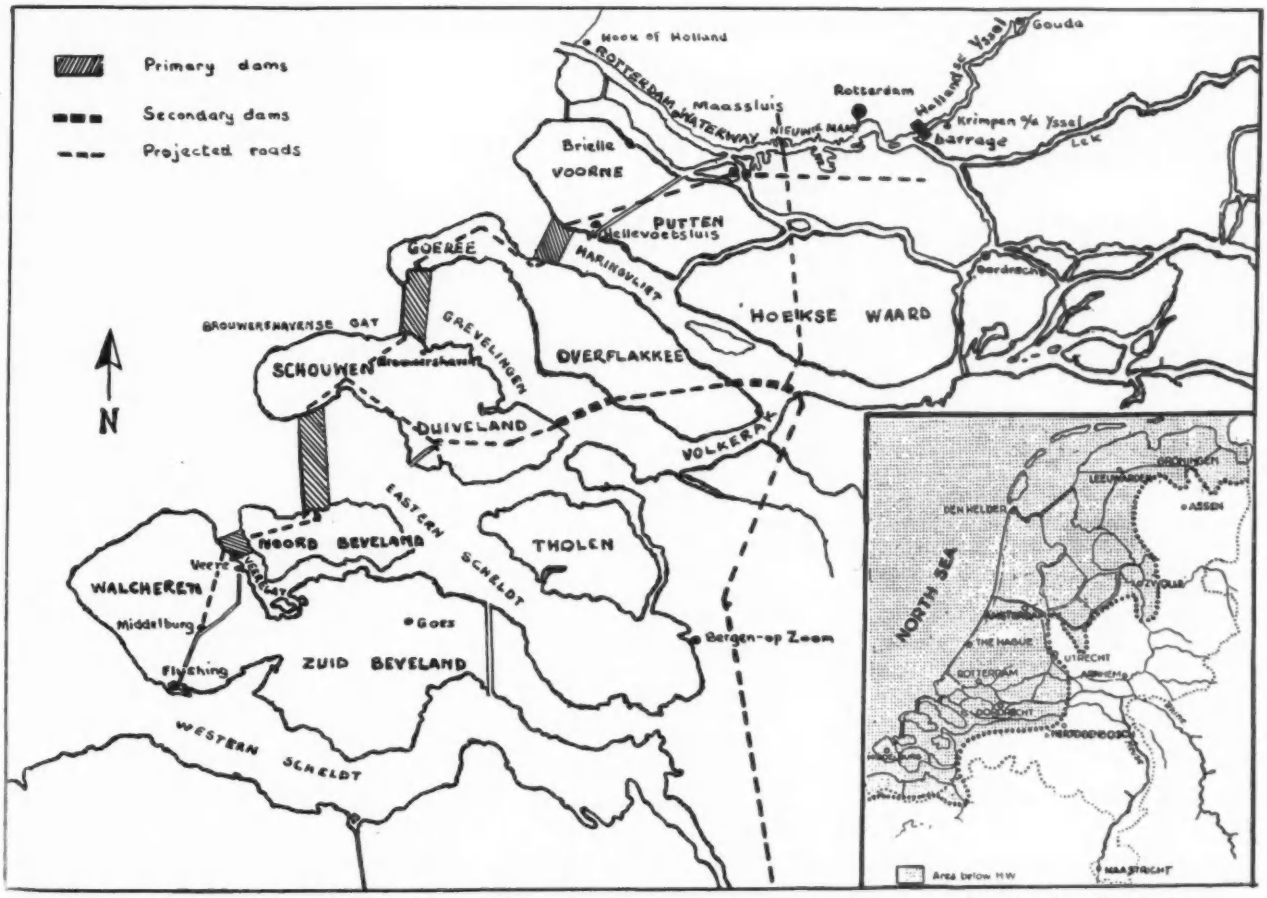


Fig. 1. Map of Holland showing the positions of the main and secondary sea-defence dams across the estuaries, also the barrage in the Hollandse Yssel. Fig. 1a (inset). The shaded land area is that part of the country lying below high water level which would be flooded in the absence of sea-defences.

The Delta Plan—continued

adopted as a basis for the design of future sea defence works in the south-western part of the country. The probability of this level being exceeded was computed to be under one per cent. in a century.

The Delta Plan

The task of devising practicable ways and means of preventing a recurrence of the flood disaster was entrusted to a Commission — named the Delta Commission — which was installed by the Minister of Transport and Waterways in February 1953. The recommendations of this Commission, as embodied in its third interim report issued in the following year, formed the basis of a scheme which has come to be known as the Delta Plan.

In principle, two alternative methods are available for solving the problem. The first of these is to increase the height of the existing dykes by an amount of 1½ to 2 m. Such a scheme would present some serious practical disadvantages, however. Many of the dykes concerned pass close to built-up areas where the raising and widening operations would necessitate the demolition of large numbers of houses, harbour installations, etc. Furthermore, the old dykes are known to be unsound in places. The defective spots are not always easy to detect and could thus in some cases continue to be weak links in the chain of defence.

The second alternative, which is the one adopted by the Delta Commission, is to seal off the tidal estuaries (except the Western Scheldt, which is the access waterway to the great Belgian port of Antwerp) by the construction of dams (Fig. 1). The effect of this will be to replace the existing highly indented and vulnerable coastline by a relatively straight and therefore much shorter one. The new defences against the sea will be formed by the natural sand dunes at the western extremities of the islands and by the new dams to be constructed across the mouths of the estuaries. The dunes are in most places already high enough to ensure adequate protection, and it is considered to be both technically and economically feasible to build dams which will be 1½ to 2 m. higher than the existing dykes around the islands. It will moreover be possible without undue difficulty to increase the height of these dams at a future date, should this become necessary in consequence of the gradual progressive subsidence of the whole western part of the country.

In broad outline the Delta Plan envisages the execution of the following principal civil engineering works:

(1) Four primary dams across the mouths of the Haringvliet, Brouwershavense Gat, Eastern Scheldt and Veeregat respectively.

(2) Four secondary dams some miles inland from the mouths of the inlets. The object of these secondary dams is to modify and improve hydraulic conditions in the network of estuaries and waterways and thus to facilitate the construction of the primary dams.

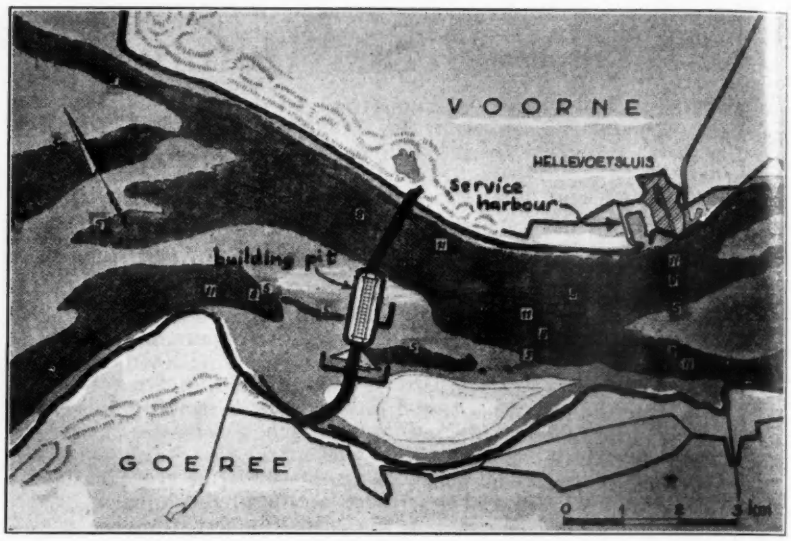


Fig. 2. Projected dam across the mouth of the Haringvliet, showing the temporary ring dyke around the building pit for outfall sluices.

(3) Strengthening and raising the existing dykes situated seaward of the primary dams as well as those along the Western Scheldt and the Rotterdam Waterway.

(4) The construction of a movable barrage across the mouth of the Hollandse Yssel, where it discharges into the Nieuwe Maas to the east of Rotterdam.

(5) Various ancillary works in connection with drainage, navigation, etc.

The existing dykes around the islands will be maintained as a useful second line of defence.

Where necessary, the projected new dams will be provided with navigation locks and with outfall sluices for the discharge of water into the North Sea. The enclosed estuaries will have sufficient capacity to store the water discharged by the rivers and the drainage water from the surrounding polders during prolonged gales, when the outfall sluices will have to remained closed.

In addition to protecting the lives and property of the population of the south-western part of Holland, the Delta Plan will yield a number of other advantages. Thus, it will result in the formation of a large fresh-water basin which will counteract the effects of salinity and drought in an extensive agricultural area situated within and around the region protected by the Delta works. The water supply situation will also benefit by the scheme. Better access to the islands will be obtained by the construction of roads over the new dams. The whole south-western area will thus be integrated with the densely populated area north of Rotterdam. Navigation of the dammed-up estuaries will be much safer, as the effects of tides and currents on these treacherous waters will have been eliminated. There will, however, be ample scope for inland aquatic sports and recreation on the vast area of protected water thus obtained. The shellfish industry (oysters and mussels) which flourishes in the islands will suffer some disadvantage, but every effort is being made to minimise this by the construction of appropriate ancillary works.

The execution of the Delta Plan will take 20-25 years, at an estimated cost of between £150 and £200 million.

The present position (spring 1958) with regard to the progress of the engineering works is as follows. Construction of the dam across the mouth of the Haringvliet is well under way. A start has been made with the closure of the Veeregat. The barrage in the Hollandse Yssel is nearing completion. Work is to begin shortly on the secondary dam across the Grevelingen. The construction of this dam, which connects the islands of Schouwen-Duiveland and Overflakkee, is a necessary prelude (from the point of view of hydraulic conditions) to the construction of the primary dams across the Brouwershavense Gat and the Eastern Scheldt, which are scheduled to start in 1960 and 1965 respectively. Similarly, the secondary dam across the Volkerak (between Overflakkee and the mainland) is closely associated with the execution of the Haringvliet primary dam. Construction work on this secondary dam will also soon begin.

As the barrage in the Hollandse Yssel will be completed this year and as the closure of the Haringvliet has already made a fair amount of progress, it will be of interest to consider these two projects in greater detail.

The Haringvliet Dam

A considerable proportion of the flow of the Rhine and Maas is discharged through the Haringvliet. The dam across the mouth of this important estuary (Fig. 2) will therefore have to be provided with outfall work of very ample dimensions to cope with the large quantities of water seeking an outlet to the sea.

The Delta Plan—continued

The alignment adopted for the dam and outfall sluices was determined on the basis of exhaustive hydraulic and hydrographic studies. Two other possible alignments—one at the extreme mouth of the estuary and one farther inland from the finally selected alignment — were investigated and discarded.

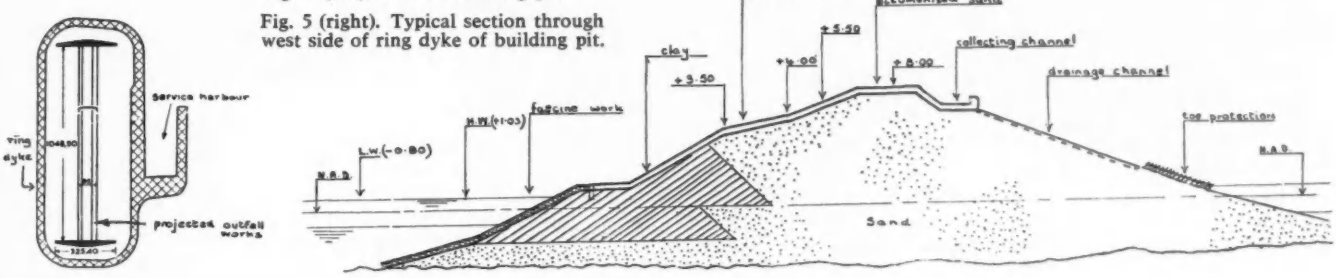
The sill level of the projected sluices is 5.50 m. below Normal Amsterdam Datum (N.A.D., corresponding approximately to mean sea level). As a profile of flow of 5500 m² is required in these conditions, the sluice gates must have an overall width of 1000 m. Including the width of the piers between the sluice openings, the structure will have a total length of about 1050 m.

An essential preliminary to the actual work was the construction of a large service harbour at Hellevoetsluis, in the island of Voorne. This harbour, which was completed in October 1956, serves as a maintenance and supply base for barges and other floating plant and is also used as a refuge harbour during bad weather. Adjoining it are extensive storage areas for construction materials. Facilities at Hellevoetsluis furthermore include offices, service buildings and accommodation for engineering staff and labourers.

The operation of damming up the Haringvliet is expected to take about 12 years to complete. In broad outline the various works have been programmed as follows: 1 year for the construction of the building pit, 5 years for the construction of the sluices (Fig. 4), 3 years for dredging the approach channels and constructing underwater revetments, 1 year for building the southern portion of the dam (i.e., south of the sluices), 2 years for building the northern portion of the dam.

Fig. 3 (left). Plan of building pit.

Fig. 5 (right). Typical section through west side of ring dyke of building pit.



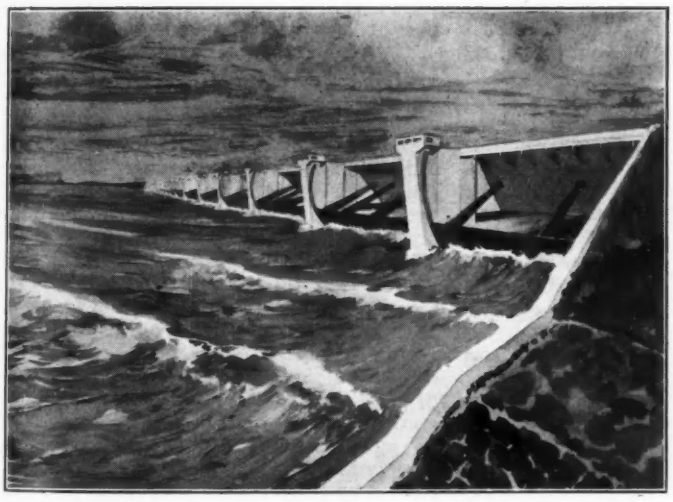


Fig. 4. Artist's impression of the Haringvliet outfall sluices.

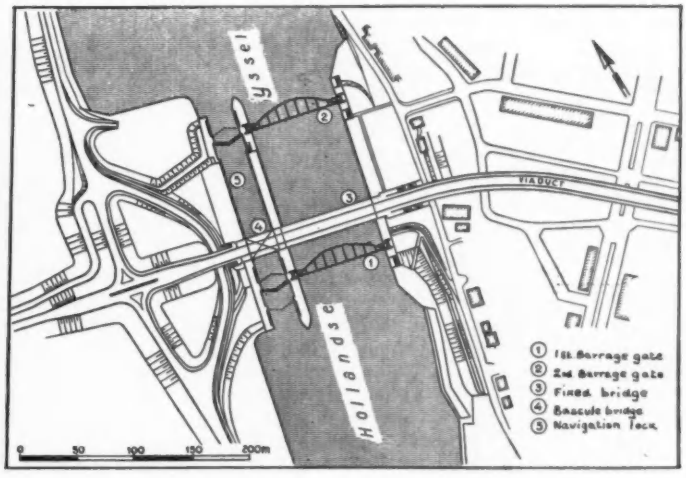


Fig. 6. Plan of the barrage and navigation lock in the Hollandse Yssel.

between the end pierheads. The preliminary design for the outfall works envisages 17 openings, each 56.50 m. in width.

It is essential to complete the sluices before building the dam itself, as they will greatly assist in reducing the velocity of the tidal current flowing through the final gap in the dam before closure is effected. The first step in constructing the sluices has been to provide a huge building pit (Fig. 3) in the shape of a rectangle 560 m. x 1400 m. in size, enclosed by a dyke of sufficient height and strength to afford adequate temporary protection for the works to be executed within the pit. On the east side this artificial island containing the pit is provided with a service harbour for the unloading of plant and materials.

Construction of the Building Pit

The contract for the construction of the building pit for the future outfall sluices at the mouth of the Haringvliet was let in December 1956. The lowest tenderers, who submitted a price of about £1,700,00, were a combine of four contracting firms. Construction of the ring dyke around the pit started in February 1957 and was completed in the spring of 1958. Following completion of the dyke, the water within the pit has to be pumped out and the pit trimmed up before a start can be made with the construction of the outfall sluices.

The dimensions of the building pit are governed by the overall length of the outfall structure, the size of the end pierheads, and the requirement that there shall be sufficient space in the pit for storage and working areas. The shape of the rounded corners of the rectangle was determined on the basis of hydraulic model tests.

The ring dyke has an external toe of clay behind which rises the main embankment (Fig. 5) consisting of fine sand (0.1—0.2 mm. particle size) dredged locally. The clay toe extends to above high-water level. The underwater portion of the toe is protected by brushwood fascine work weighted with 800 kg. of rubble per m². Above mean sea level protection is provided by a revetment composed of a 20 cm. thick layer of bitumenised sand which is covered (up to a level of +5.50 m. with respect to N.A.D.) with a layer of "asphalt concrete" (stone-filled asphalt). The dyke along the west (or seaward) side of the pit has a 3 m. wide flat crown at a level of +8.00 m. The external slope is provided with a berm, 10 m. in width, at +3.50 m. Below the berm the slope is 1 in 4; above the berm it is 1 in 3. A short distance below the crown the internal slope of the dyke has a collecting channel for water from waves which

The Delta Plan — continued

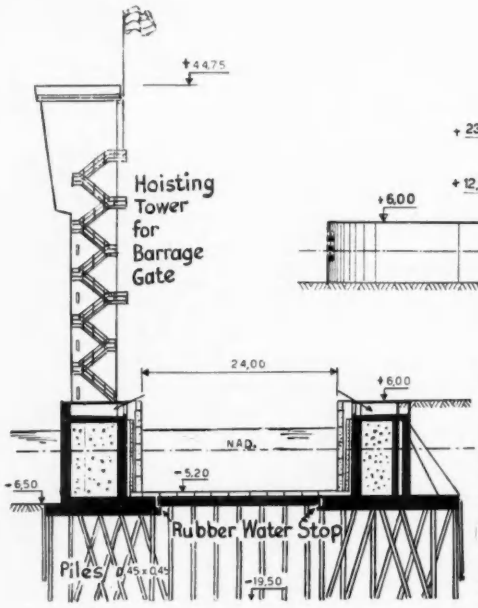


Fig. 7 (left). Cross-section through entrance pierheads at south end of lock.

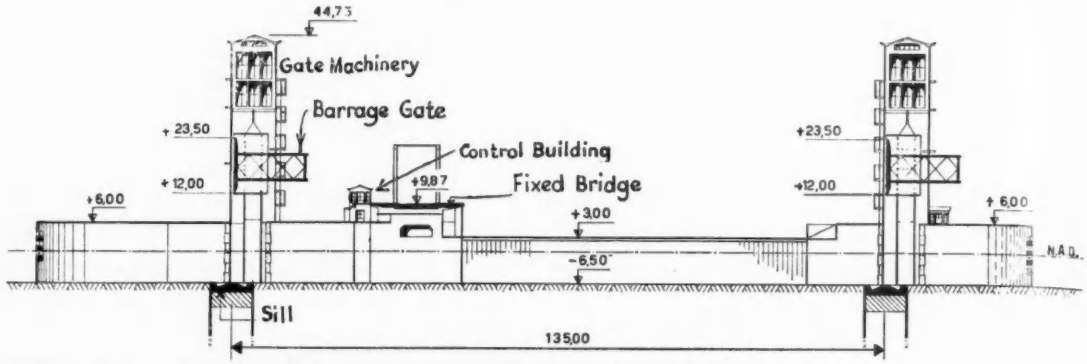


Fig. 8 (above). Longitudinal section through main opening (storm barrage gates in raised position).

may overtop the dyke. On the east (or lee) side of the pit the dyke is lower and less heavily protected. The mean depth of water in which the ring dyke had to be constructed varied from about 2 m. at the south side to about 8 m. at the north side.

Construction of the dyke started in the shallow water at the south side. The clay embankment forming the toe was placed by means of floating cranes equipped with grabs. The sand forming the main body of the dyke was excavated by suction dredgers and placed by pumping supplemented by dumping from hopper barges. At the same time a start was made with constructing the base of the dyke in the deep water on the north side of the pit. The base was formed by sinking rubble-weighted brushwood mattresses alternating with 0.50—1.50 m. thick layers of sand placed by hopper barges.

Reduction of the flow profile of the Haringvliet due to the construction of the ring dyke gave rise to increasingly high tidal current velocities with the consequent risk of scouring of the bottom and damage to the dyke itself. For this reason a row of protective brushwood mattresses was placed along the whole northern half of the dyke on the west side of the pit so as to provide a scour-resistant base. A dam of coarse gravel (4—30 cm. in size), about 250 m. in length and extending southward from the north-west corner of the pit, was placed on this brushwood base. The purpose of this auxiliary dam was to act as a barrier for checking the current. While it was being constructed, work was also in progress on the west dyke itself, which was being extended northward from the south-west corner of the building pit. At the end of June 1957 the remaining gap of about 220 m. between the north end of this dyke and the south end of the gravel dam was closed with the aid of 20 concrete caissons. These caissons were 11 m. long, 7.50 m. wide and had a height of 3 m. Once the gap had been closed, the construction of the rest of the west dyke could proceed in relatively calm water. This dyke in its turn provided effective protection for building the dykes along the north and east sides of the pit. The final gap in the ring dyke was closed in November 1957.

The construction of the building pit necessitated the placing of 2,660,000 m³ of sand, 180,000 m³ of clay, 120,000 tons of waste stone from the coal mines (this material was used chiefly for building the service harbour on the east side of the pit), 21,000 m³ of bitumenised sand, 6,500 m³ of " asphalt concrete," 220,000 m² of brushwood mattress and toe protection work, 57,000 tons of weighting rubble for sinking the brushwood mattresses, 53,000 tons of large rubble, and 41,000 tons of coarse gravel. The excavation of the pit and the construction of the service harbour involved 1,420,000 m³ of dredging.

The Barrage in the Hollandse Yssel

The Hollandse Yssel was once a branch of the River Lek, which itself is an important branch of the Rhine. It was dammed up at two points, in the middle ages and in the 19th century respectively, but its lower reaches continued to be in open communication with the Nieuwe Maas and thus with the sea.

During the floods of the 1st February 1953 the dykes along the Hollandse Yssel proved inadequate and were in grave danger of being breached by the rising water. A disaster of appalling magnitude—the inundation of the whole of the densely populated area north of Rotterdam—was prevented only in the nick of time by the application of drastic emergency measures to sustain and strengthen the threatened dykes.

The only effective safeguard against the recurrence of such a crisis consists in sealing the Hollandse Yssel as close as possible to the point where it enters the Nieuwe Maas. The construction of a permanent dam across the river would have presented some serious disadvantages, however. In the first place, such a dam would have adversely affected the complex hydrological conditions in the adjacent areas. A further consideration is that the town of Gouda discharges its sewage into the river and relies on the tidal movements for getting rid of pollution.

It was accordingly decided to build a movable barrage capable of being opened and closed at will. This structure (Fig. 6) would have to be of such dimensions as to permit the unrestricted flow of tidal water into and out of the river under normal operating conditions (i.e., other than during storm tides, when the gates would be closed) and would have to present the least possible hindrance to navigation.

The scheme which has been adopted for closing the Hollandse Yssel comprises the construction of a navigation lock, two barrage gates, and bridge works.

The barrage gates, which are of the vertical-lift type, are installed one behind the other and provide an opening 80 m. in width when raised. They move between hoisting towers, and their sills are at a level of −6.50 m. with respect to N.A.D., thus presenting a flow profile with a cross-sectional area of about 500 m², which is approximately equivalent to the existing profile of the river. A fixed highway bridge crosses the river between the two gates and provides sufficient headroom for most river craft. Sea-going vessels are, however, built in shipyards situated on the river upstream of the new barrage. To provide unrestricted headroom for the exit of these vessels and furthermore to enable general shipping to pass the barrage when the gates are lowered, the projected works include a navigation lock situated on the west side of the 80 m. wide main opening.

The Navigation Lock

The lock (Figs. 7 and 8) has a width of 24 m. and an effective length of 120 m. The larger sizes of sea-going vessels, which are too long to be accommodated within the lock chamber, will be able to pass through the lock only at the turn of the tide, when the gates at both ends can be simultaneously opened for a time. The lock is equipped with five steel mitre gates, each consisting of two leaves. There are two gates at the north end—for use at high and at low tide respectively—while the south or downstream end is equipped with a

The Delta Plan—continued

similar pair of gates and, in addition, a storm gate. All the gates are identical and interchangeable. The sill level of the lock is −5.20 m. with respect to N.A.D. The tops of the gates are at +5.00 m.

The north and south entrance pierheads of the lock are of hollow reinforced concrete construction and are filled with sand. The walls of the lock chamber consist of anchored steel sheet-pile walls.

Each leaf of the lock gates weighs about 60 tons and is of all-welded steel construction, consisting of skin plating provided with vertical stiffeners, horizontal girders, and a series of bracings to ensure adequate strength and rigidity. The gates, which are electrically operated, can be opened or closed in 3 minutes. Each leaf is equipped with sluices for filling and emptying the lock chamber.

The Barrage Gates

In the closed position the level of the tops of the vertical-lift barrage gates (Fig. 9) is +5.00 m. with respect to N.A.D. The sill level is −6.50 m. When raised, the undersides of the gates are at +12.00 m. Each gate weighs about 625 tons and is raised and lowered between two reinforced concrete towers containing the driving machinery and a set of counterweights. The gates are electrically operated, power being obtained from the Rotterdam and Dordrecht mains supply; a standby diesel generating set is also provided. The gates are lowered at a speed of 2 cm/sec while above water; as soon as they enter the water the speed is reduced to 2/3cm/sec. The closing operation takes about half an hour to complete.

The clear distance between the hoisting towers of each gate is 80 m. The head of each tower contains two storeys. The upper storey accommodates the driving machinery; the sheave wheels for the counterweights are installed in the lower storey. The tower is furthermore provided with steel guide rails for the runner wheels of the gate.

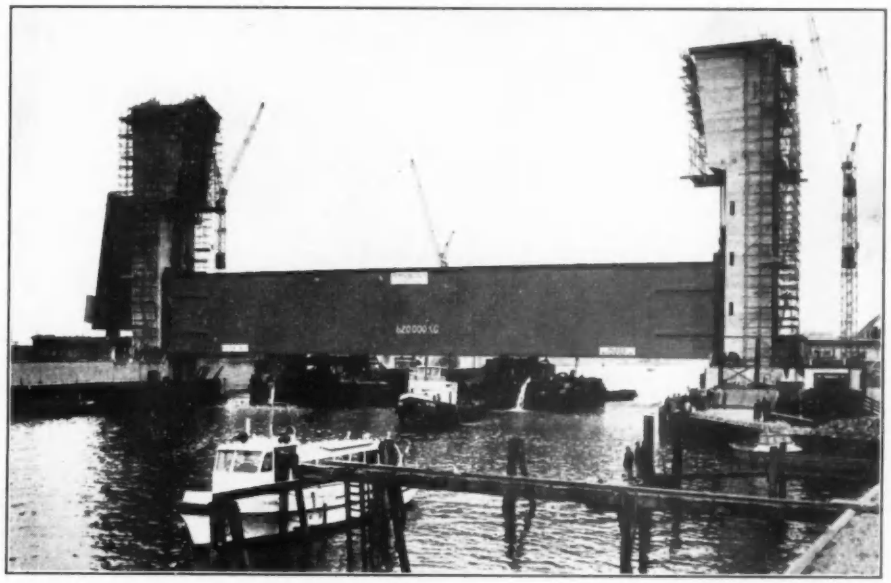


Fig. 10. First barrage gate in process of being erected between the hoisting towers.

Each gate is composed of a vertical steel skin stiffened by longitudinal and transverse girders which are supported by two horizontal bow-string type main girders, the whole structure being comparable to a bridge placed on its side. The skin plating has been designed as a so-called orthotropic plate. Each end of the gate is suspended from eight Seale-Warrington galvanised steel-core wire ropes running over two sheave wheels of 4.80 m. diameter. The counterweights consist of reinforced concrete boxes filled with a special heavyweight concrete. Each set of driving machinery comprises two 25 h.p. motors operating at 1,500 r.p.m. and, on the same shaft, two 8.3 h.p. motors operating at 500 r.p.m. The latter are used for lowering at reduced speed. The motors drive the main rope drum through 1 in 175 reduction gearing. The four hoisting cables are of similar construction to the counterweight cables. The gates are equipped with a special device for disengaging them from the meeting faces in tne event of unequal water pressure occur ring on the two sides of the skin plating, so as to overcome the excessive friction that would otherwise impede the raising or lowering movement.

The south barrage gate has been completed and was installed between its hoisting towers in December 1957 (Fig. 10). The skin plate was fabricated in sections up to 6 m. x 10 m. in size which were transported to an assembly yard at Dordrecht, where the whole gate was assembled and then floated into position on barges.

The north gate, which will act in a reserve capacity, will be completed in 1-2 years' time.

The mid-stream portions of the sills of the barrage gates were constructed in cofferdams made of steel sheet-piling driven into the river bed. The end portions of the sills were constructed in the two main cofferdams on the east and west side of the river respectively. The navigation lock and the foundations and substructures of the hoisting towers were built in these main cofferdams.

The subsoil on which the barrage and lock in the Hollandse Yssel had to be constructed is very poor, consisting mainly of soft clay and peat. A sand stratum capable of carrying structural loads occurs at a depth of about −20 m. The soil conditions necessitated the driving of 3,000 reinforced concrete piles (45 cm. x 45 cm. in section, with a safe bearing capacity of about 70 tons). About 90 per cent. of these were raking piles. The sills of the barrage gates are carried on hollow steel piles made of two Larssen sheet-pile sections welded together and forming an integral part of the sheet-pile cut-off walls under the sills. The

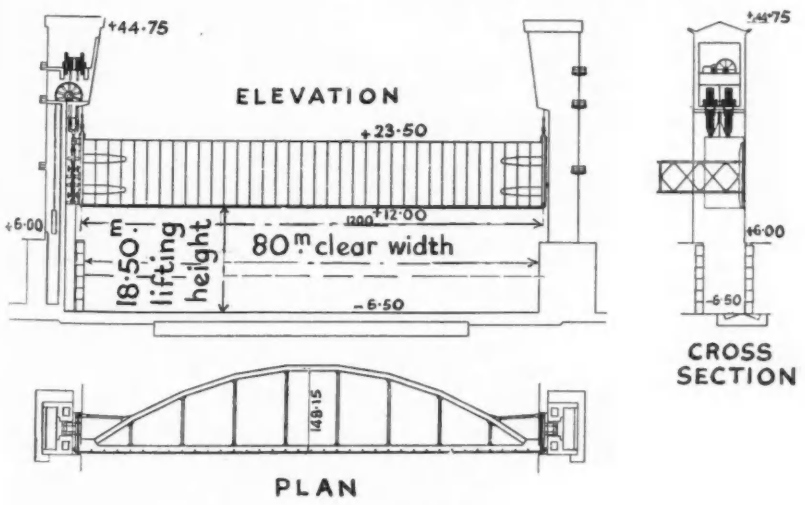


Fig. 9. Barrage gate.

The Delta Plan—continued

sills themselves have been given a special shape, based on model tests, with a view to preventing scour of the bottom of the river by the high current velocities that occur under the gate when it is being closed.

The Bridges

The waterway is bridged by a steel lattice-girder type fixed bridge spanning the 80 m. wide main opening and by a bascule bridge over the lock chamber, which is 24 m. in width. The fixed bridge is situated between the two barrage gates. It has a 7 m. wide roadway and 5 m. wide cantilevered cycle tracks and footpaths on either side. The deck consists of a steel plate, 10 mm. thick, covered by a 5 cm. mastic asphalt wearing course. The construction depth of the bridge is 1.00 m. The roadway level is +9.87 m.

The bascule bridge is of the same width as the fixed bridge. It has two main girders with cross-girders and stringers carrying a timber deck covered with a thin asphalt wearing course. The bridge is electrically operated; a new mechanical speed control system has been adopted in preference to electrical control. Opening or closing the bridge takes only two minutes.

Both bridges were erected in December 1957. The fixed bridge was floated into position. The bascule bridge was installed with the aid of cranes.

The bridge approaches on the west bank of the river consist of a system of roads built on earth embankments. On the east bank poor soil conditions necessitated the construction of an approach viaduct founded on piles. This structure, which is about 560 m. in length and has a maximum gradient of 1 in 42½, is constructed partly in reinforced and partly in prestressed concrete. It is supported on over 800 bitumen-coated prestressed concrete piles and (in the case of the two piers nearest the river) on 50 steel piles. The prestressed portion of the viaduct is a continuous structure. The beams are of precast pretensioned construction and were made on the site with the aid of a special prestressing bed.

Dry Docks in Norway & Sweden

By L. H. POWELL

In the July 1957 issue of "The Dock and Harbour Authority" there was published the first article of the series on Modern Dry Docks; their design, construction and equipment. This gave an analysis of the position existing in the U.K. and the author stated further that it was hoped to be able to give in future issues brief details of dry dock facilities throughout the world. The October 1957 issue contained a short article on the dry dock situation in the United States of America, and this month we include a list of the dry dock facilities in Norway and Sweden.

Both Norway and Sweden possess dry dock facilities of a high order. The former country has a merchant fleet of over 8,000,000 tons gross, a shipping traffic for imports and exports (tonnage entered and cleared) about one-sixth of Great Britain's and a shipbuilding industry in something like the same proportion.

The following is a list of docks of over 400-ft. in length and capable of accommodating vessels of 7,000 d.w.t. and upwards.

	Type	Length ft.	Approx. d.w.t. capacity
Sarpsborg			
Mek. Verksted			7,500
Moss			
Mek. Verksted	Floating	400	—
Oslo			
Aker Mek. Verksted ...	Floating	580	30,000
Aker Mek. Verksted ...	Graving	570	18,000
Nyland Mek. Verksted ...	Floating	—	12,000
Horten			
Marinens Hovedverft ...	—	450	—
Tönsberg			
Kaldnes Mek. Verksted ...	Graving	—	15,000
Sandefjord			
Framnaes Mek. Verksted	Floating	533	24,000
Kristiansand			
Mek. Verksted	Graving	443	—
Stavanger			
Rosenberg Mek. Verksted	Graving	520	17,000
To be increased by 1959 to			85,000
Haugesund			
Mek. Verksted	Floating	—	17,000
Bergen			
Mek. Verksted	Floating	—	20,000
Trondhjems			
Mek. Verksted	Floating	—	8,000
Harstad			
Kaarbö Mek. Verksted ...	Graving	400	7,000

In addition, some of the yards listed, as well as others, have a number of smaller docks.

Sweden's merchant fleet is smaller than that of Norway, being in the neighbourhood of 3,000,000 g.r.t. In the particulars below, the lifting capacity of the docks is given. This does not denote gross or deadweight tonnage of ships (which is considerably more) but the weight the dock can lift. Ekensberg shipyard at Stockholm, for example, has two floating docks of up to 3,200 tons lifting capacity (about 7,000 tons d.w.).

		Type	Dimensions ft.	Lifting capacity tons
Stockholm				
Ekensberg shipyard		Floating (2)		3,200
Finnboda shipyard	(1)	Floating	478 x 78	8,200
	(2)	Floating	400 x 62	6,750
A. B. Hammarbyverken	(1)	Floating		1,000
	(2)	Floating		350
Gothenburg				
A. B. Götaverken	(1)		426 x 82	8,000
	(2)		595 x 82	18,000
	(3)		713 x 100	28,000
Lindholmen		Graving	587 x 79 Depth for dockgate 25-ft.	
		Floating	266 x 47½	2,100
Eriksberg	(1)	Floating	230 x 44	1,850
	(2)	Floating	418 x 65	7,750
	(3)	Floating	643 x 90	23,500
Falkenberg				
Falkenberg shipyard		Floating	243 x 45	2,100
Halsingborg				
Helsingborg shipyard	(1)	Graving	289 x 40¼ x 12¾	
	(2)		367 x 52½ x 16¼	
Malmö				
Kockums	(1)	Dry dock	210-ft. long	
	(2)	Dry dock	534-ft. long	
	(3)	Dry dock	617-ft. long	
Ramvik				
Gustavsvik repair yard		Dry dock	462 x 68¾ x 26¼	
Oskarshamn				
Oskarshamn shipyard		Graving	131 x 17.4 x 4.7 metres	
Sölvesborg				
Sölvesborg shipyard		Graving	340-ft. long	
Uddevalla				
Uddevalla shipyard	(1)	Floating		10,800
	(2)	Floating		800
Landskrona				
Öresundsvarvet A.B.	(1)	Graving	631¾ x 93½ x 24	
	(2)	Floating	330 x 48	2,800

Humber Ports Development

Progress in Post-War Reconstruction at Hull and Goole

(Specially Contributed)

A COMPREHENSIVE description of the Humber Ports was contained in a series of specially contributed articles in this journal from August 1954 to April 1955. In these articles mention was made of the post-war engineering works which had already been carried out and of some which were at that time projected. The British Transport Commission were recently hosts to the Maritime and Waterways Division of the Institution of Civil Engineers, whose members were enabled to inspect some of the works in progress and witness the considerable advances that have been made in Hull and Goole in making good war-time destruction and furthering the development of the Humber Ports.

Riverside Quay and Albert Dock

The largest of the works visited was the reconstruction of the Riverside Quay and the south side of the Albert Dock in the Port of Hull. These works, which are rapidly approaching completion, are shown in Figs 1 and 2. The site is unusual in that the Albert Dock is separated from the River Humber at this point by a narrow strip of land varying in width from some 200 to 300-ft. Along the southern edge of this strip the Riverside Quay existed pre-war for a length of half a mile. The masonry quay wall of Albert Dock and various transit sheds erected upon it comprised the northern edge of the strip. Wholesale destruction by enemy action brought to a close the important general cargo and passenger services that had operated from these quays, but the facilities are now being reconstructed on the most modern lines (Fig. 3).

The reconstructed Riverside Quay, over 1,000-ft. long, has an apron some 25-ft. wide and is backed by three sheds each 280-ft. long by 83-ft. wide with 60-ft. wide intervening spaces. At the rear of the sheds is a 10-ft. wide loading bank. An unusual feature is that, in perpetuation of an existing right of way, a public footpath is being provided over the top of the sheds. The four sheds on the Albert Dock Quay are each 288-ft. long and the intervening spaces are 54-ft. wide, the length of quay being about 1,500-ft. The front of the sheds is founded on the old masonry wall and an apron 36-ft. wide is provided by a false quay in front of the old wall.

The sheds are of reinforced concrete construction with barrel vault roofs and are entirely free from internal columns. A significant feature of the barrel vault roof which is 3¼-in. thick at the crown is that no waterproofing cover to the concrete is being provided. Reliance is being placed on the high quality of the concrete to resist permeation by water and no "day work" construction joints are permitted, each barrel being poured in one continuous operation. The performance of this unusual feature will be watched with great interest.

Fig. 1. Riverside Quay under construction, showing steel sheet piling at toe of existing pitched slope, pre-cast concrete frames and deck units, with barrel vault sheds in course of erection on the completed length of quay.

Fig. 2. Pre-cast concrete lateral and longitudinal frames in Riverside Quay construction.

The riverside quay construction exhibits much ingenuity. The piles 18-in. x 18-in. and 14-in. x 14-in. in section and 70-ft. long depend on the frictional resistance of the strata through which they are driven more than on toe bearing. They are of precast concrete and are post tensioned on the "Lee McCall" system. The piles are cast in three sections, the central section which is 57-ft. long being made hollow to reduce weight. The existing pitched slope over which the quay is built on the riverside is stabilised against deeper dredging to 19-ft. 6-in. M.L.W.S. by steel sheet piling driven at the toe of the slope and cut off slightly above low water.

To obviate in-situ reinforced concrete bracing below deck level and thus avoid the difficulties in construction and maintenance involved in tidal working, a system of precast lateral and longitudinal concrete frames is being used. The principle of precasting is continued into the deck so as to dispense with shuttering over the water. An in-situ deck slab above the precast concrete deck units provides continuity. A system of timber fenders is supported on greenheart piles, driven into the river bed whilst their heads are cushioned against the quay deck structure by hollow rubber cylinders.

In the case of the Albert Dock Quay use is made of the existing masonry wall to support the rear of the new quay structure. Except for the absence of lateral and longitudinal precast frames, the construction and fendering is similar to the quay on the riverside.

The quays will be equipped with electric level-luffing semi-portal cranes, the rear of the cranes being supported on the top of the sheds. Three 7½-ton cranes and six 3-ton cranes are being provided on the Riverside Quay and one dual capacity 10/3-ton and eight dual capacity 6/3-ton cranes on the Albert Dock South Quay. Rail tracks run behind the sheds and beneath the cranes on the Albert Dock Quay.

Humber Ports Development – *continued*

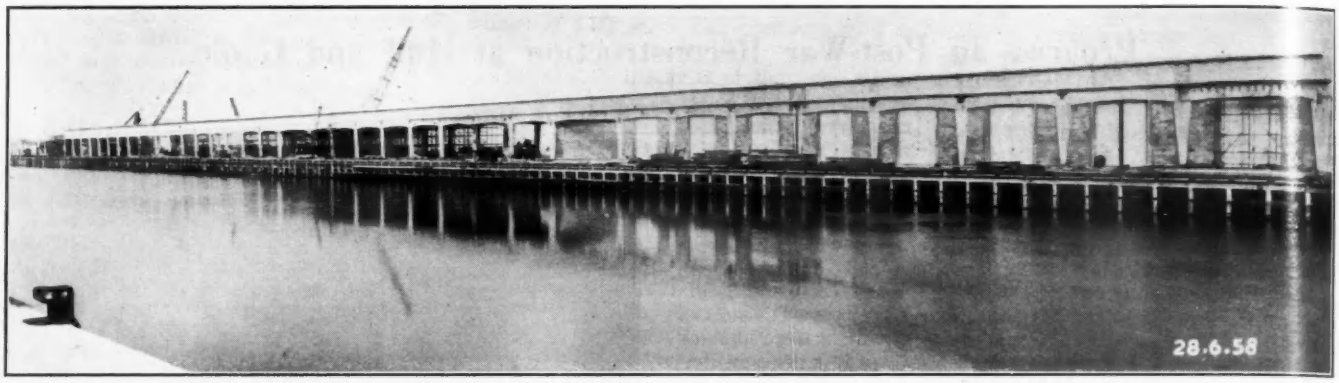


Fig. 3. Albert Dock Quay transit sheds under construction.

An attractive building in contemporary style which is to provide passenger accommodation with facilities for Customs and Immigration staff also exhibits extensive use of precasting.

The concrete throughout the works is of the highest quality, the strength and not the mixture being specified.

The consulting engineers to the Commission for these works are Messrs. Sir Bruce White, Wolfe Barry and Partners, and the contractors are Messrs. A. Monk and Co. Ltd.

The estimated cost of the works including cranes and quay equipment is about 1½ million pounds.

St. Andrew's Dock

St. Andrew's Dock which is some seventy-five years old, is one of the great national centres of the fishing industry. On the north side of the dock some 250-ft. of quay wall collapsed when a floating mine was detonated in the dock. Some years later a further 350-ft. partially collapsed and adjacent lengths moved forward slightly. The damaged wall which was rather slender by modern designed standards, was made of lime concrete and it was decided to replace it by a mass concrete wall of greater section with a much wider base.

The work is being carried out within a steel sheet piled coffer dam some 600-ft. long (see Fig. 4). The ends of the dam and a central diaphragm are driven through the existing masonry wall. The dam is tied back to a steel piled anchor wall by high tensile steel rods. The adjacent lengths of wall which have moved forward slightly have been similarly tied back, the tie rods being thrust-bored under the existing market buildings on the quays. The reinforcement in the toe of the new wall is welded to the steel sheet piles forming the front of the coffer dam. These piles will be cut off at the level of the toe of the wall and will assist in preventing any tendency towards overturning.

The contractors for the works are the Demolition and Construction Co. Ltd.

King George Dock

The largest and most important dock in Hull is King George Dock, opened in 1914 (see Fig. 5). In this dock the reconstruction of No. 12 Quay, over 1,300-ft. long, was described in the issue of this Journal for January, 1955.

Recently completed is the comprehensive re-equipment of the dock with 6/3-ton electric level-luffing portal quay cranes of which forty have been supplied. The crane and rail tracks have been renewed and the old stone setts replaced by flush concrete paving. In addition, four 120 tons per hour pneumatic grain elevators have been provided, discharging into underground conveyors passing along the quays to the 40,000-ton capacity silo situated at the head of the dock. In connection with this programme of re-equipment, the electric distribution system throughout the dock has been completely modernised and converted from D.C. to A.C. Two floating grain elevators each delivering 200 tons per hour have also been provided.

Fig. 4. Steel sheet pile cofferdam for rebuilding of gravity wall.

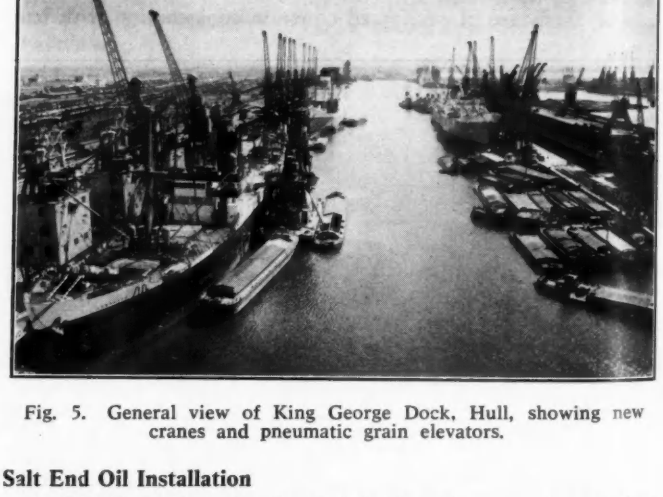


Fig. 5. General view of King George Dock, Hull, showing new cranes and pneumatic grain elevators.

Salt End Oil Installation

At Salt End where the Port of Hull's oil storage installations are sited, work has commenced on the replacement of the existing timber No. 1 Jetty by a reinforced concrete jetty with two berthing heads designed to accomodate ocean-going tankers up to 27,500 tons d.w., and dredged to a depth of 36-ft. at M.L.W.S. Facilities are also included for Coasters and River Barges.

At the landward extremity reclamation works which will give

Humber Ports Development—continued

access to the new jetty have already been completed. The jetty will project some 1,600-ft. into the river, the approach which will carry fifty-seven pipes on three tiers being almost 1,200-ft. long before it branches to the two berthing heads. One head 396-ft. long will accommodate either one ocean tanker or two coastal tankers on the river face and will have three barge berths at the rear. The other head 258-ft. long to be built after the existing timber jetty has been demolished will accommodate one ocean tanker or one coastal tanker, alternative moorings being provided. In the jetty heads vertical and raking steel Rendhex box piles are to be used to carry the reinforced concrete berthing face which will be fendered by hollow rubber cylinders in diagonal formation. Modern appliances are to be provided for handling the flexible hoses between the ships and the pipelines.

The consulting engineers for the works are Messrs. Coode and Partners and the contractors are the Yorkshire Hennebique Contracting Co. Ltd.

The Port of Goole

At Goole, a small but busy member of the Humber Ports, a major activity is in the export of coal, both for coastwise shipment and to the Continent. The canal system of British Waterways enables collieries to deliver coal by water and this is done by trains of floating steel tanks each of 40-tons capacity known as Compartment Boats, the leading unit of which is powered for towing. When they arrive at Goole these Compartment Boats are lifted bodily in specially designed Boat Hoists and their contents tipped into the ships' holds.

Except for two coal hoists of conventional design, all coal arriving by rail is shipped by cranes which can be used for heavy cargo lifts of up to 50-tons when not required for coaling. The wagons run on to cradles housed in pits within the railway track. The cradle and wagon are hoisted together by the crane, the slings being arranged so that the wagon cants to one end and the end door of the wagon is opened to permit the coal to discharge into the ship's hold.

As part of the modernisation of quay equipment at Goole, work is proceeding at the west side of the Railway Dock on the preparation of a piled crane track for a new 50-ton coaling crane. Development of the south side of West Dock has alrealy been carried forward by the provision of additional crane and wagon tracks in flush concrete paving and two new dual capacity 7½/3-ton electric level-luffing portal cranes are being erected for general cargo and bulk discharge of vessels. A similar development is following on the north side of West Dock.

Following the complete overhaul of Ouse Lock 264-ft. long and 58-ft. wide, work is proceeding on the repair of Victoria Lock, 500-ft. long and 47-ft. wide, another of the four lock entrances which give access to Goole Docks. The lock has been dried out within steel sheet piled coffer dams and repairs to the sills and quoins are in hand as well as overhaul of the three pairs of mitre gates. The gates are of timber construction and operated by chains and winches which are being changed from hydraulic to electric power.

The existing timber lead-in jetty and lie-up berth in the river immediately adjacent to the lock is being reconstructed. Steel sheet piles are being driven outside the existing line of the jetty and tied back by high tensile rods to a sheet piled anchor wall on the land side. The existing timber work will be cut down to a suitable level and filling will be placed behind the sheet pile wall. The jetty will then be decked in reinforced concrete with a concrete cope and a system of timber fenders.

The Small Port and its Problems

Difficulties of Maintaining a Balanced Economy

(Specially Contributed)

The increasing size of ships, particularly tankers, has recently directed attention to the functions that ports perform and how well, or how poorly, they are equipped to cope with the problems posed by modern vessels. Basically, a port is a tool for processing cargoes that are brought within its limits. The difficulties which face the large ports and which receive their full share of attention, are often found in an intensified form in the small ports of the world. Defined as places where 1 million tons deadweight of general cargo (excluding shipments in bulk) can be handled annually, there are a large number of such harbours on the Continental littoral alone. Each has its own problems. Not all have managed to survive through the centuries. The industrial, physical and climatic changes that have rendered some of them obsolete are still at work, the process intensified by the pressure of modern conditions.

What are the problems that are common to the majority of small ports? Firstly, all ports, whatever their size, are difficult and expensive to construct and to maintain in working condition. They must be built with not only an eye to the future developments and needs of the area, in so far as these can be foreseen, but, in the case of open ports, to take advantage of such physical protection as the surrounding country affords. At the same time, positions that are subject to excessive scour, winds or siltation will prove expensive to maintain and to keep clear. Few small ports enjoy the advantages of an estuarial position flanked by navigable tributaries and a canal system that will favour the quick dispersal or concentration of seasonal traffic. In the hinterland of each port there should be industries, including agriculture, which can be relied upon not only to provide staple exports but to attract a steady tonnage of raw materials, including fertilisers, in satisfaction of their needs. From the fluctuating demand of these industries for labour will, in all probability, come the marginal supply of dock labour on which the port must depend for peak shipping periods.

It is only too well known how quickly political and industrial changes, apart from the normal variations in popular demand for certain products, can affect such industries. Forming, as it may well do, a high proportion of the port's traffic, the economic prospects of a small port may be blighted overnight by a change in fiscal policy that would pass almost unnoticed in a major port. Disease in a citrus crop, for example, which could bring a Mediterranean port almost to a standstill, could hardly be said to affect the port of London, which merely notes that the shortage of supplies from one source has been made up from another.

Small ports are not small scale editions of large ports, neither is there a particular type of vessel (excluding native coastwise craft) that enters exclusively the small port. The same vessels, subject to size, draught and the physical conditions of each harbour, can be seen in the small as well as the large ports. A tramp of 12,000 tons will require 500-ft. of good sound quay, well equipped with appliances for handling her cargo, and with 30-ft. of water alongside, whether she be discharging a part cargo in a small port or a full cargo in Liverpool. The same goods, requiring the same expert handling may pass across the quays in both places. In the smaller port it is unlikely that the discharge will be able to rely on an efficient overside system.

Problem of Congestion

This introduces perhaps the most pronounced handicap of the small port—lack of space. Built to satisfy the needs of the times, the port area often huddles within a thickly populated area where expansion is impracticable. It takes very little extra tonnage to congest the quays and sheds. Open space is quickly exhausted; climatic conditions may not favour open storage. The receivers upon whom the port authority depends to clear the quays find their own limited premises quickly congested. Rather than impede further their productive processes they are content to leave cargo in the docks. Sheds intended for transit purposes are utilised to supply warehousing needs and the small port can quickly grind to a stop. Keeping goods on the move across the quays is so serious a problem that even large ports have become alive to the dangers inherent in permitting goods to remain uncleared beyond a nominal period. Small ports know no quicker way of committing suicide. The East African Railways and Harbour Administration, as recently as July 1, 1957, gave notice that they would no longer undertake general ware-

The Small Port and its Problems—continued

housing, thus making available in the port of Mombasa a further 173,000-ft. of much needed transit space.

The economic mean for small ports is therefore much more rigid than could be tolerated in a larger port. It is a fact commonly accepted, although there is little mention of it in port publications, that there is a number of vessels normally using a port that will enable that port to work at its most economic form. One might liken it to the cruising speed of a car. If, for instance, the economic mean for a large port is 100 ships then the days when there are only 70—80 will show an increase in the ratio of overhead costs to tonnage; there will be labour not gainfully employed, although this may be hidden. Should there be 150 ships at work then some labour of poor quality will be employed, supervision will be extended to the detriment of efficient handling, much overtime will be worked and methods will show a general tendency to become wasteful. Whilst every port knows its own mean figure the larger port can tolerate unperturbed a percentage fluctuation that the smaller port with its fewer resources could not comfortably face.

Problem of Limited Handling Resources

In large ports the considerable quantities of cargo received regularly by large industrial concerns have produced economical methods of concentration and handling that benefit both the port and the receiver. The pre-war London Terminal Market for bagged sugar is an example. It was possible in a season to handle as much as 100,000 tons, at a low rate, directly from the carrying vessel and to pile this quantity in warehouses adjacent to the discharging berth. The post-war discharge into silos of bulk sugar completes the port picture of the economic handling of a staple import made possible by the conditions in large ports.

Little on these lines can be done in the small port. Quantities are too small and arrivals too infrequent to make port installations economic. At the same time it is expected that many of the facilities regarded as normal in the larger ports should be available, if required, in the smaller places. A port that could not provide even a primitive bulk grain or coal and ore handling plant would be handicapped in seeking the traffic that, in face of fierce competition, it must constantly attract to its quays. To provide the funds for such essential installations is the one problem that is never absent for long from the small port authorities. Not only are cargo facilities expected. The expanding local industry may require new machinery, too heavy for either the carrying vessel to discharge or for the port cranes to handle. A heavy lifting floating derrick is beyond the capacity of the port's resources; neither would there be an economic demand for such plant even were tidal and climatic conditions favourable to joint use by ports within a convenient range. Powerful tugs to aid ships in difficulties are often beyond their means also.

Large ports with ample resources have long since accepted such plant as unlikely to give an economic return whilst being essential, if the port is to attract business. The same argument can be applied to the ship as to her cargo. Repair facilities, and these include dry docks, expensive to build and maintain, are apt to be taken for granted. Whilst the port authority is expected to provide them, they can rarely count on a guaranteed use. They have, by now, accepted a cost of so much per ton of goods handled, in respect of these port facilities. Should a small port provide floating derricks and dry docks it must be reconciled to a much greater cost per ton on the limited cargo that its quays can handle.

Not all ports enjoy the freedom from climatic extremes that in this country is taken for granted. Protection from sun in hot countries and from the intense cold, that can play havoc with cargo handling gear and equipment, in arctic conditions, all adds to the expense of running a small port. In a large port, accommodation built to give protection to seasonal crops, could and would be used probably for general cargo during the remainder of the year. Similarly, a bumper harvest can quickly swamp the small port and disrupt its general cargo traffic.

For so long port authorities of major ports have been accustomed to meeting and overcoming the demands that busy periods make, that the very limited resources that their colleagues at the minor ports can command have seldom been appreciated. In a large port area extending for several miles it is not often that work is proceeding at the same intensity throughout. Those parts where work is slack can aid those which are busy. Not only labour but supervisory staff and equipment, including, nowadays, mobile cranes and fork-lift trucks, can be transferred quickly. What is rightly regarded as a normal proceeding in a large port would be the envy of many a small one that knows only too well the physical limitation of local labour that it must face. Neither can it offer the regular work that would attract more dock labour to the neighbourhood.

It would be an over-simplification to assert that the same organisation is necessary to lock in a 500 ton coaster as a 20,000 ton cargo vessel. It would be correct to say that the cost certainly does not increase as the size of the ship. Dues on vessels form a major source of income to a port. A dock which can take small ships only may well fail to recover in dues the cost to which it is put in providing and operating the service. On the other hand, where there is a continual movement of large vessels through the locks the income from the Entrance will subsidise such installations as floating cranes, dry docks and tugs. From this follows the acceptance by many small ports that an expensive locking system—and it is expensive with the 24 hour attendance necessary—cannot be afforded. The handicaps implied in tidal conditions, the settling of ships on the mud and the time lost in the longer hoist by cranes and the virtual extinction, in some ports, of the ship's gear as a cargo handling aid must all be accepted. Those who are famliar with conditions at, for instance, the port of St. Helier, in the Channel Islands, will have noted the additional time taken with each lift from the hold of a vessel which at low tide may be 45-ft. below the quay level.

Since the late war few ports of whatever size have not had to face the heavy cost of modernising their internal road system. Seldom are these classed as public roads that attract government or municipal aid. Whilst terminal charges are collected on rail traffic, so far little is known about attempts to levy tolls on vehicles using the dock roads, parking places and circulating areas. The improvements, often of a major character, have been accepted as part of the post war pattern, and large ports have absorbed the cost of these. It is different with a small port, that, in providing the means of access essential to the over-size Continental lorries, can cripple itself in so doing. Again, the small port feels acutely the subsidised rail traffic that has robbed it of much of the coastal shipping on which it once relied.

To sum up conditions in the small port, there is often found there an intensity of use which would rapidly choke a larger port. By expert organisation and knowledge of local conditions it is possible to work "all-out" for a long period without the aid of alternative outlets such as craft and coastal shipping. Small ports have always to be on their toes. The Suez incident, which inconvenienced the larger ports, dealt a severe blow to those with fewer resources. They need to develop a suppleness that will allow them to profit immediately from such developments as the European Common Market. They are not unaware of the problems posed by container traffic and they know how quickly their quays can become congested unless they can ensure that such cargoes, easily landed, are quickly cleared.

In the last two centuries there has been a noticeable movement in the larger ports towards a segregation of traffic demanding similar facilities. In a large port this is possible and it has been encouraged because of its obvious economy in port working. Thus, in London, the West India Dock was built for the purpose of unloading sugar and rum from the West Indies. The East India Dock catered for the vessels of the Honourable East India Company; the Surrey Commercial Docks for grain and timber. To-day, small ship traffic is largely concentrated in the London Docks, medium sized cargo vessels in the India Docks, grain in the Millwall and Royal Victoria Docks, timber in the Surrey and liners in the Royal group and Tilbury. This is a sound and economic arrangement that enables shipping to make the best use of the port's facilities. Viability on this scale is an inestimable advantage of a large port; it is denied to the small port.

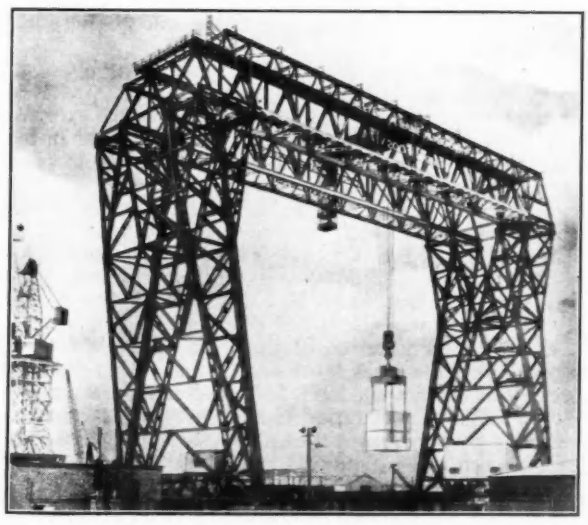
Nuclear Power Station at Bradwell

The Nuclear Power Plant Company, Ltd. is building one of the first commercial nuclear power stations for the Central Electricity Generating Board at Bradwell-on-Sea, Essex. During construction work on the reactor buildings, a 177-ft. high Goliath crane, claimed to be the largest of its type in the world, is being used to enable the largest components to be lifted with ease, and to allow civil engineering work in the reactor buildings to proceed without being hindered or delayed by the installation of the boilers and pressure vessels.

The Goliath Crane

The crane has been designed and erected by Messrs. Clyde Crane and Booth Ltd., Manchester. It is of the overhead girder type, supported at each end by a leg mounted on standard 4-ft. 8½-in. gauge track 1,200-ft. long, which enables the crane to completely straddle the site and carry equipment from the reception centre to any location. Designed to lift a maximum load of 200 tons deadweight suspended vertically from a main hook, the crane is also provided with an auxiliary hook capable of lifting a 30-ton load. The crane structure may be dismantled on the completion of the work for which it was intended and erected on another site.

The crab is of conventional design mounted on rails along a pair of girders. Each of these main assemblies incorporates a complementary outrigger girder to impart the required degree of lateral stiffness. Each supporting leg is pin jointed at its base to the top equaliser beams of the bogies, which transmit the load to two other equaliser beams coupled to the pairs of bogies through universal connections. This arrangement enables the load to be evenly distributed to all the axles in each of the four bogies. A 20 h.p. motor drives the front and rear axle of each bogie through reduction and spur gearing, and the eight motors for traction purposes give the crane a speed of up to 50-ft. per minute when carrying a load of 200 tons. The main and auxiliary hoists are each driven by two 50 h.p. motors, the main hoist being capable of raising 200 tons at 4-ft. 9-in. per minute, and the auxiliary hoist 30 tons at 33-ft. per minute. Eight solenoid brakes are fitted to hold the crane when at rest, normal braking being obtained by plugging through the control gear. In the event of extremely bad weather storm clamps are provided to ensure further safety anchorage for the crane.



The new Goliath crane erected at Bradwell.

In order that the driver may be informed of the alignment of the two sets of bogies an indicator is provided in the cab. Should "skewing" in the legs occur provision has been made for re-alignment by braking the bogies on one leg and separately driving those of the other leg.

All electrical power for the Goliath is supplied by a Crossley-engined generator set. The engine is a three-cylinder two-cycle pump diesel engine, of 10.5-in. bore and 13.5-in. stroke, developing 400 b.h.p. at 600 revolutions per minute. This is direct-coupled to a 200-Kw. direct current generator, and the combined set is mounted on a steel baseplate together with a radiator for cooling the engine circulating water and lubricating oil.

Heavy Unit Transported by Sea

The delivery by sea last May of the first of twelve Heat Exchangers for the Power Station presented new and intricate problems to both the builders Messrs. Head Wrightson and Co. Ltd., and the towage contractors, Messrs. William Crosthwaite and Son, the Managing Owners of the Cross Line Tugs.

Each of these units is a vertical pressure vessel of 1.9/16-in. thick plate 19-ft. diameter over the major portion of its length,

The start of the voyage from Thornaby-on-Tees to Bradwell

with a 20-ft. diameter section at the base. The overall height of each shell is 92-ft. 4½-in. and the weight 200 tons. On account of their size these vessels could not be delivered in one piece by road or rail, neither was it possible to deliver the vessel broken down into rings. It would have been possible to deliver them broken down piece small, i.e. each plate separately, but the complexity of operations and the need for specalised supervision in the assembly on site away from the works made it advisable to look for another alternative.

The geographical position of the fabricating shops and the site of the Power Station both being situated on rivers on the East Coast appeared to offer a solution, and it was considered that by completely fabricating these vessels in the works, launching them into the river, towing to destination—a distance of 297 miles—and finally hauling out of the river at site, was the best answer to the problem.

The decision to deliver these huge Exchangers by sea was perhaps more courageous than would appear at first sight as one of the most vital features of the operation was that they should not come into contact with anything from the time of launching at Thornaby-on-Tees until they were landed on the specially constructed ramp at Bradwell. Any contact with the ground or extraneous objects would have subjected the high grade welding to stresses or damage unacceptable to the Atomic Energy Commission. There are over two thousand appertures in the carcase which had to be made watertight and the many fittings and excrescences protected against danger from the sea. No ballasting could be permitted but at the same time they could not be allowed to turn over during the long sea passage South. By far the greatest problem however, was the last mile of the journey. A large deep drafted sea tug could not tow the units up the Bradwell Creek which is shallow and tortuous, and small shallow drafted tugs had to be chartered and their crews trained for their part in the operation.

The first Heat Exchanger was launched according to plan before a large gathering at Thornaby-on-Tees on Friday, 16th May and was picked up by the Voith-Schneider tug "Hutton Cross" which manœuvred her down river where the sea tug "Fiery Cross" awaited her. Unfortunately the sailing had to be postponed as gales were forecast over the route and she was tied up at buoys overnight, setting sail the following morning passing out of the river Tees at noon.

(Continued at foot of following page)

British Wood Preserving Association, 1958 Convention

Discussion on Chemically Treated Poles

(Specially Contributed)

The B.W.P.A. Annual Convention held at Cambridge from July 8th to 11th was attended by 250 delegates, including representatives from Australia, Canada, Denmark, France, Germany, Holland, Norway, South Africa and Sweden. Seven papers were presented and a film " Wood at Work " prepared by Koppers Co. Inc., U.S.A., was shown to delegates.

Paper No. 1 by Mr. P. M. D. Krogh, Officer-in-Charge of Wood Preservation at the Forest Research Institute, Pretoria, was entitled " A marine exposure test of chemically treated poles and untreated controls in South African Harbours." The author gave the reasons for initiating this series of tests and described a design for testing the efficacy of various wood preservatives when impregnated into wood and exposed to the ravages of wood destroying marine borers attended by other destructive factors. The text of this Paper was printed in full in the July issue of this Journal.

Paper No. 2, was on " The Permeability of Wood and its importance in Timber Preservation," by Mr. D. N. Smith, Head of the Preservation Section at the Forest Products Research Laboratory, Princes Risborough. This presented fresh facets on the problem of the penetration of wood by fluids. The theoretical basis of permeability having been stated the author then discussed those factors which from a practical standpoint affect fluid flow, e.g. viscosity and mean free path, which itself depends on the radii of vessels in hardwoods and peculiarities in the bordered pits, especially the tori, on coniferous tracheids.

Paper No. 3, was by Ing. Vladimir Rubes of the Research Institue of Wood Technology, Prague and dealt with " The Penetration of Preservatives into Refractory Woods."

Paper No. 4, by Mr. Claude Sisley, was on " Some Curiosities of Fungal and Insect Attack on Timber."

Paper No. 5, by Mr. D. Boocock, a Director of The Standardised Disinfectants Co. Ltd., was on " Treatment of Timber against attack by insects and fungi in warm climates." This Paper brought up to date the knowledge of Ambrosia and Powder-post beetles and included useful sections on sapstain fungi and on preservative measures against insects and fungi.

Paper No. 6, on " Some Organic Solvent Types of Timber Preservatives in Germany," was prepared by Dr. G. Becker, Bundesanstalt fur Materialprufung, Berlin-Dahlem. Dr. Becker's paper outlined the merits and demerits of organic solvent type preservatives:

(a) against wood-destroying fungi.
(b) for the destruction of wood-boring beetles.
(c) against termites and
(d) against shipworm and gribble.

Paper No. 7, by Mr. Sten T. Henriksson, Bolidens Gruvaktiebolag, Sweden, was on " Some Experiments with Oscillating Pressures in Wood Impregnation."

Discussion on Paper No. 1

During the discussion period on Mr. Krogh's paper certain speakers expressed the view that there was some indication that marine timbers were often attacked by *Limnoria* following an attack of soft rot. Although it was generally agreed that insufficient information was at present available to reach any final conclusion on this subject, it was felt that there did appear to be some good grounds for this belief. In reply to a question as to whether the salinity and temperature of the water affected the hazard of attack by marine borers, Mr. Krogh stated that in certain areas where a survey was carried out the colder the water the less severe was the attack.

Dr. R. C. Fisher of the Forest Products Research Laboratory referred to the fact that before starting the experiments in Durban Harbour a full biological survey had not been carried out. He felt that such a survey might have helped those responsible for the experiments to select the best sites for the tests. He considered that a lack of knowledge of the fauna in the test areas would to some extent restrict the value of the tests.

Mr. Krogh explained that biological survey work was now being carried out. In the case of Durban Harbour it was fortunate that having selected this site before completing the biological survey even after doing such a survey, it was still the site which would have been selected for experimental work.

Dr. G. Becker of the Bundesanstalt fur Materialprufung, spoke on the connection between *Limnoria* attack and soft rot fungi. He stated that from various parts of the world there did seem to be information indicating that if timber could be kept free from attack by soft rot, then it would not be attacked by *Limnoria.* He mentioned experiments which indicated that certain preservatives with copper components appeared to give satisfactory protection against attack by marine borers. He wondered if this was also in some way connected with the fact that the soft rot fungi were sensitive to copper compounds and therefore by giving protection against soft rot attack, the hazard of marine borer attack was reduced. Dr. Becker also referred to the effectiveness of BHC against crustaceans.

Much discussion took place on the treatment methods employed by Mr. Krogh in his experiments in South African waters and on the test species. It was hoped that when the experimental work referred to in Mr. Krogh's paper and reproduced in the July issue had produced further results, Mr. Krogh would present a further paper for publication in this country.

Mr. Krogh was asked how he accounted for the number of specimens destroyed which had been treated with 5% pentachlorphenol in A.W.P.A. Creosote ex Iseor. He stated that the the reason for the breakdown was the low absorption of only 7.25 lbs. per cubic foot which he considered too low for marine work. Mr. Krogh was also asked whether test specimens which failed stood up for a period of time and then suddenly broke down or whether the breakdown was gradual. He explained that test specimens did not suddenly fail but that the breakdown was gradual. When deterioration caused by marine borer attack reached 50% of the cross-sectional area in a test piece that particular specimen was withdrawn.

Nuclear Power Station at Bradwell—continued

The " Fiery Cross " which carried out the towing operation is a new geared diesel tug with a Kort Rudder commissioned in 1957 and is capable of a pull of 18 tons, equivalent to approximately 1,500 b.h.p. She was made fast to the tow by means of 45 fathoms of 3½-in. wire shackled into 75 fathoms of 7-in. nylon rope. This was shackled into a special constructed bridle consisting of two legs of 4-in. wire 70-ft. in length and each leg was in turn shackled into a lifting lug on either side of the Exchanger.

When clear of the river the tow followed well, covering the first 50 miles in 7½ hours at a speed of 6¾ knots. This speed was maintained throughout the passage and the tug came to an anchorage in the early morning on Monday, 19th May. Two shallow drafted tugs the " Alert " and the " Nimrod " which had been chartered from Wivenhoe then took over the Heat Exchanger and commenced to move her up Bradwell Creek. Weather conditions were perfect and the passage up the creek went according to plan.

At the Bradwell site a concrete slipway had previously been built, down which a road low-loader could be run to act as a cradle. The exchanger was floated into position above the loader and as the tide fell the weight of the unit was taken by the loader which was then hauled out of the river with the aid of powerful tractors. It was then hauled to the Power Station site under the Goliath crane for lifting into its final position.

New Passenger Terminal at Freemantle

Work has commenced on the new two-storey passenger terminal which is being constructed for the Harbour Trust at Victoria Quay, Freemantle. A total of 300 prestressed concrete piles are being driven through the floor of F shed to strengthen the existing wharf so that it can carry the weight of the new concrete and steel building which will be 1,100-ft. long and will be built in two sections so that only one deepwater berth will be out of action at a time.

Modern Dry Docks: Design, Construction and Equipment

IX Maintenance of Mechanical and Electrical Installations

By E. S. ELY, M.I.Mech.E., M.I.E.E.

MECHANICAL and electrical equipment in and associated with the modern Dry Dock can be divided into the following four main groups:

(1) Pumping Plant including Outside Valves.
(2) Drydock Cranes and Capstans.
(3) Caisson haulage machinery.
(4) Ancillary services equipment.

Owing to the wide range of equipment and the variety of duties, each has its own particular problem in the matter of maintenance.

If the mechanical and electrical engineer is in the fortunate position of having had full responsibility for the whole plant from the early stages, he can do much to alleviate the difficulties of his maintenance problems in the future, in whichever group the equipment may be placed.

Particular attention to details in the preparation of the various specifications regarding workmanship, accessibility and ease of removal should be followed by the closest scrutiny of contractors layouts and detailed drawings sent for approval. Inspection during manufacture and tests at works should be followed by equally close attention to detail during erection. Acceptance tests should be searching and comprehensive.

Assuming that the plant has been tested and accepted, what problems of maintenance can the mechanical and electrical engineer expect during the forthcoming years?

Pumping Plant

In and around the pumping station he is responsible for a considerable variety of equipment, which may include such items of plant as

Main dewatering pumps, drainers, house service and auxiliary pumps.
Outside valves for dewatering, filling and impounding.
Control gear including starter panels and remote controls.
Transformers.
Recording and indicating instruments.

Most of these perform a full load duty of short duration followed by a long spell of quiescence often in a salt laden and humid atmosphere.

If it has been practicable to equip the station with vertically driven pumps with the motors and control gear clear of the pump well, a source of major anxiety has been removed. The additional difficulties met with when a main pump has to be dismantled for repair are outweighed by the elimination of risk to electrical equipment by flooding.

This opinion is doubtless influenced by experience of incidents in the nature of

A completely flooded pump well due to the fracturing of the casing of a steam driven pump on its final duty before replacement by an electrically driven installation.
A pump room draining valve inadvertently left open as the result of which water was discovered lapping the stator windings of the two H.V. main pump motors.
The spraying of H.V. motors and switchgear due to wall porosity when an adjacent dry dock was left "wet" for a number of days during caisson repairs.
The combination of abnormal tide and storm providing unwanted quantites of salt water through a cable culvert and over an H.V. 1,200 b.h.p. main pump motor.

Although these events took place in older pumping stations some of the hazards may well be present even in the modern station, particularly on the discharge side leading to open water, and therefore if horizontally driven pumps are being installed every possible precaution should be taken.

The layout of a drydock pumping station with motors and control gear at ground level is shown in Fig. 1. The main dewatering pump motors are of the synchronous-induction type. In the foreground are situated auxiliary pump motors for fire and water services and in the middle distance, the draining pump motors with their respective control panels adjacent. The H.V. stator air-break switch cages for two of the four main motors are located immediately under the control platform.

In regard to general maintenance, provided regular and frequent scraping and painting is carried out external surfaces in the pump well should not cause undue anxiety over the years, although dock draining pumps and valves, frequently situated at

Fig. 1.

lower levels require special observation and attention. The provision of adequate platform and ladder approaches on and around the main pumps will minimise inadvertent damage to paintwork by the operating and maintenance staff.

Internally, however, the lower casings of the main pumps will suffer deterioration if salt water is allowed to remain during long periods when the dock is dry, and routine draining is recommended

Normal wear due to erosion is manifest mainly in the cutwater and impeller eye-rings. Modern technique in welding enables the former to be built up again to the original dimensions and similarly the impeller can be restored by the provision of rings either screwed on or shrunk on to the trued-up facing.

Abnormal maintenance encountered is mainly due to foreign bodies from the drydock which find their way through protective gratings. Short planks, timber wedges, rope and sacking, all are liable at times to be found wrapped round or wedged in impellers but on only one occasion in the author's experience has the damage been such that a complete replacement was the only solution to the repair. Alertness by the operating staff in shutting down promptly when abnormal running noises have been heard or ammeter readings noted as unduly high, has saved considerable damage on many occasions.

Modern Dry Docks—continued

Fig. 2.

Fig. 2 shows a vertically driven double inlet centrifugal drydock pump with electrically operated suction and discharge valves. The latter automatically close in a few seconds in the event of electricity supply failure or emergency, a cushioning effect being provided hydraulically at the end of the closing stroke. Walkways are provided on the main pumps to facilitate inspection and maintenance and to eliminate damage to paint work.

The draining pumps, due to longer running hours and suspended abrasive matter in the flow, are subject to a high degree of wastage and replacement of impellers can be regarded as normal maintenance.

With vertically driven shafting, bearing troubles, even on the high speed auxiliary pump shafts, can be reduced to a minimum by the installation of automatic forced greased lubrication, and this system is recommended as an essential feature.

Whether or not the motors and control gear are located in the pump well, continuous warming should be provided and the installation of black heat strip radiators under the motor is to be preferred to built-in elements in the windings, the former installation allowing a direct check of correct functioning to be made.

Provided regular inspection by a qualified electrician is carried out the H.V. and L.V. switchgear and control gear should not present many problems. Air-break switches if employed on the H.V. supply to the main motors, which may be operated frequently during dewatering operations, are open to easy inspection, adjustment and contact cleaning. Flexible copper tails to the moving parts however should receive close and frequent examination as the wearing of these to breaking point can produce some spectacular results in the H.V. air-break switch cage. The protecting oil circuit breakers do not normally operate under loaded conditions but regular periodical inspection of contacts and oil testing is recommended. Tripping under overload conditions would of course call for special treatment.

With adequate heating and ventilation, control panels normally should require only routine examination and cleaning, with the exception of those operating the drainer pumps, when the more frequent operation will make for contact wear. Contactor operating coils should be a small item of expenditure when the hazard of dampness is removed and in the normal size control panel two 32 C.P. carbon filament lamps have been found to be adequate for this purpose. This method may appear to be somewhat primitive but it has the advantage of giving visual indication of failure of heat, without elaboration.

Outside valves controlling culverts, where the main pumps and drainers deal with one or more drydock and/or drydocks with centre caissons, may become a considerable item on the maintenance schedule. Situated as they are in some cases 50-ft. or 60-ft. below the cope level and under watertight platforms the conditions for maintenance work are far from easy.

The main troubles to be met are the wearing of the cross-head and valve guides, the replacement of which under the conditions presented is a difficult and unpleasant operation. A point also to be carefully watched is the condition of the final stops which prevent the valve from sitting too tightly in the wedge of the body, and which tend to corrode to a marked extent over the years. A recent examination has indicated that the wastage of metal may be augmented by electrolytic action. Inspection, adjustment and replacement should be carried out at regular periods whenever practicable. A valuable asset in these operations is a portable submersible sludge pump, capable of operating under the worst conditions and of sufficiently small dimensions to pass through the watertight platform man-hole.

Apart from wear and tear the author has had the experience of abnormal maintenance on a number of large culvert sluice valves which may be of interest. Over the years the extrusion of the metal on the screw heads and consequent eventual seizing of the nut in the cross-head, and in some cases the actual fracture of the cross-head itself presented a problem which caused considerable worry and expense.

After tests had been carried out over a long period the metal of the screw and type of thread were modified on the assumption that more load was being encountered than was anticipated in the design, particularly in opening the valve. This, however, although bringing about an improvement did not effect a cure. Difficulties were finally resolved by the replacement of a manually operated lubricating system by automatic forced greased lubrication, not only to the cross-head nut but both to cross-head and valve guides. It is anticipated that maintenance and replacement will be considerably reduced in the future.

The location of the headstock, motor and control panel below ground level in a humid atmosphere presents the possibility of rapid deterioration unless adequate precautions are taken. The effect of condensation can be partially overcome by cork treatment of the roof, but frequent scraping and painting of this equipment, which being outside the pumping station is inclined to be overlooked, is essential if anything approaching normal life is to be anticipated. Special mention of the conditions of service of the motor windings and contactor operating coils should be given in the specification. Under no circumstances should tools and lighting be operated at a voltage higher than 55 volts A.C. to earth in valve pits.

Transformers, possibly due to their comparatively silent service with no moving parts, are inclined to be omitted in the maintenance programme. Apart from oil testing, which it is recommended should be carried out annually, occasional lifting and examination of the transformer cover should be made. The conditions of the underside will indicate any acidity in the oil, and apart from this, the opening up will give an opportunity of checking and tightening where necessary the main connections and of observing the condition of the bushes. The question of

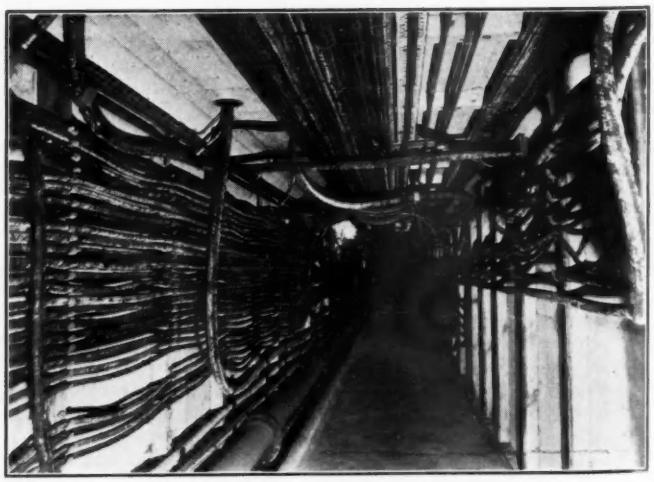


Fig. 3.

Modern Dry Docks—continued

cleaning or replacement of the oil will be dependent on the report of the annual sample tests. The former operation can be carried out on site at a reasonable cost.

Cables

The troubles which one may expect from cable work and connections depend almost entirely on the method employed and care taken in the installation stage.

In the modern pumping stations it is normal for cable culverts to be provided and these should be of sufficient height and width to allow of easy access to all cables, which, in the case of main connections should be supported on separate hangers. Identification labels liberally spaced are essential for rapid tracing. Secondary wiring to the control board is for the same reason best supported on trays rather than enclosed in conduit.

The main cables to the outside valves and caisson, together with those for the indicator lights, can be accommodated in the drydock cable culvert. Where crossing of the drydock is required, a cable tunnel is the ideal solution provided the paper insulated cables are " drained."

This may not be always practicable and the alternative which has proved satisfactory is the provision of a cable recess in the sides and floor of the drydock, the cables being supported in cleats and protected by robust thick timber or concrete covers let in flush with the sides and floor. In passing through from the pump house basement, the cable conduits must be rendered watertight by some form of plastic conduit, otherwise when drydock culverts drain into the dock, impounding above normal high tide level may produce unexpected flooding. Fig. 3 shows the complexity of cables in a pumping station, the control wiring being located overhead in the culvert.

Drydock Cranes

Provided that corrosion is reduced to a minimum, drydock cranes can expect a much longer life than quayside cranes, because their operations are carried out at a leisurely pace and they are seldom subjected to maximum loading. Much can be done at the specification stage by calling for draining holes in platforms and wherever a pocket is formed, or water can collect. Later a regular schedule of painting should be instituted which in the author's opinion should not exceed five years.

Fig. 4 shows a modern 50-ton screw luffing 90-ft. radius drydock crane with an auxiliary 10-ton jigger hoist block, in the process of dismantling its 50 year old predecessor. Fig. 5 shows a 20-ton 110-ft. radius balanced jib level-luffing crane undertaking official acceptance tests.

The arrangements of platform on three sides of the jib heads and apex sheaves and the easy approach to jib heel pins and derricking nuts considerably assist lubrication and maintenance.

As regards machinery, provided adequate means of lubrication are installed and are utilised by the maintenance staff, expense on account of mechanical replacements throughout the life of the crane should be comparatively light. It is, however, a wise precaution to provide either an overhead centre steel joist in the smaller cranes, or in the case of heavy cranes an overhead hand operated crane. These will assist in the removal of motors, or other components needing shop repair, to a point of egress in the machinery house where a door or a removable side panel is located. The question of the advantages of centralised lubricating points is debatable. If it is practicable and economical to allocate one particular crane driver to a drydock crane he should have ample time to operate individual lubricators, and what is more important, to examine the parts to check that the lubricant is getting through. It is, however, suggested that the lubrication of electric motor bearings should be allocated to the maintenance electrician.

With the employment of centralised lubricating points the effect at the far end is frequently neglected and this applies particularly to jib-head pulleys, jib heel-pins, luffing screws, and other parts which are normally out of sight from the gantry platform. It should be appreciated in the design stage that bearings cannot be adequately greased throughout their lengths by the provision of one centre way through the pin and branches therefrom. Invariably after a time the end nearest the supply starves the other points. Separate ways through the pin are the only satisfactory solution.

The travelling motion is prone to more maintenance troubles than the other motions because of the heavy duty involved in starting against the inertia of a crane which might weigh up to 600 tons and because of the long distances which have to be

Fig. 4.

travelled by the crane. If the number of travelling operations and the shock impact on the gearing, especially whilst stopping, can be reduced, abnormal maintenance will be proportionately diminished. The advantage of the provision of a jigger hoist motion may not be fully appreciated in relation to the former, particularly when blocks are being set for the incoming vessel, and in other operations where comparatively light loads are being transported from dockside to ship or vice versa. In view of the impossibility of the running away of the crane under normal service conditions, the easing of the travelling brakes to allow of a quiet and more prolonged application has been found to reduce wear and tear, of the gearing to a minimum.

To assist in the removal of travelling wheels the provision of jacking pads and bolted bogie end-plates should be called for in the specification.

The unequal sharing of the load of the travelling motors, according to the position of the jig, may bring about the overheating of travelling motors and cable work. In view of this and the duty which the motor performs a reserve of B.H.P. is to be recommended. The designer in estimating is rather apt to forget also the possible condition of the interstices of the crane track during ship repairing operations. The adherents to the method of a single motor drive with shafting may be regarded as somewhat old-fashioned, but from the point of view of equal load sharing and brake maintenance it still must have the advantage over individual corner drives.

With the electrical equipment controlling the various motors comprising mainly master controllers and contactor panels, maintenance should consist principally of contact examination and replacement and dealing with the occasional failure of contactor coil or ballast resistance. To assist the maintenance staff in tracing faults it is essential that all panel connections should be brought to terminals, that main and control terminals should be arranged in separate groups, and that terminal numbers or

Modern Dry Docks—continued

lettering should be the same at both connection ends, whether it be on master controller limit switch contactor panel or motor. Electro mechanical brake D.C. shunt coils with their high self induced E.M.F. can cause considerable damage to motor windings unless precautions are taken, and unfortunately if one is not aware of the cause, several incidents of punctured windings may easily occur before the trouble is located. In addition to a damping device complete isolation of the brake circuits and the contactors is advisable. This also eliminates the possibility of the brake's holding off on an earth fault which although not so serious when the lowering motion is electrically controlled, nevertheless is not desirable.

Although V.I.R. cables in conduit are frequently employed the author is of the opinion that from a maintenance point of view an installation with V.I.R. lead covered cables fixed to a perforated cable plate has many advantages. It is admittedly more expensive to instal but it has the virtue of freedom from condensation, ease in tracing and replacement, individuality in earth faults and freedom from consequent damage after arcing. With the ever increasing complication of crane control its introduction may be well worthwhile. The increase in cost may be amply recovered in increased crane operational time. With the larger machinery spaces of the drydock crane most of the cable runs need no special protection against damage.

Fig. 6 shows the machinery house of a drydock crane with main hoist barrels in the foreground and the jigger hoists and traversing motions beyond the overhead hand operated crane. The method of cable installation on cable plate may be of interest.

Mechanical brake wear and consequent relining, once a major item, has been reduced very considerably because with dynamic braking the function has changed to one of scrubbing and holding rather than arresting.

The main ropes of a drydock crane by virtue of the fact that they are only occasionally called upon to carry full load have, unless subjected to damage, an incredibly long life—provided additional internal lubrication is called for and insisted upon in manufacture and provided that regular external treatment is given during service. This also presupposes that all sheaves are of adequate diameter for the size of rope. The question of replacement of heavy drydock crane ropes particularly that of the main hoist, is often a difficult one to answer. Tonnage, years of service and " needling " as in the case of quayside cranes do not apply by way of guidance. Opening up of the rope may prove nothing and leave a possible weakness. On balance in view of the risk involved it is preferable to renew on the basis of years of service irrespective of apparently good condition. The rope manufacturers will be discouraged to know of hoist ropes on the main blocks remaining in good condition and service for 20 years

Fig. 5.

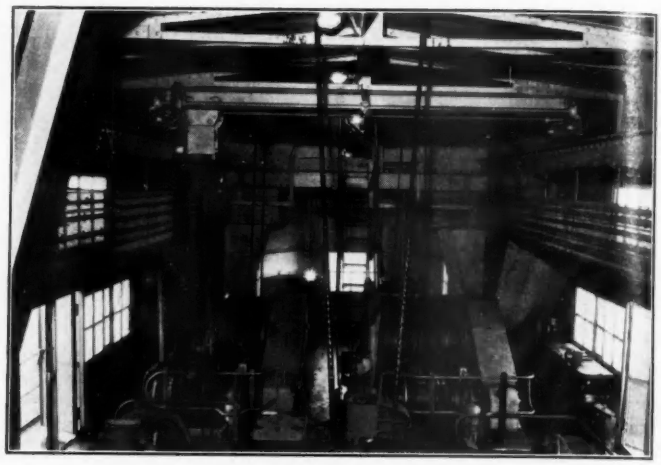


Fig. 6.

and over. The twisting of the hoist wire and block particularly in the case of two or four falls is an unwelcome and usually an unexpected addition to the maintenance programme, involving as it does in most cases the complete unreeving and running out in order to remove the unwanted turns. In the author's experience, however carefully the new rope is reeved and gradually loaded there are inherent turns even in a " non-rotating " rope, which eventually manifest themselves in the long drop to the bottom of the drydock.

Apart from this, the occasional awkward lift, particularly when propeller shafts are being withdrawn, may bring about the same effect. Relieving swivels can be introduced in some cases e.g. in the jigger hoist, but normally the main hoist reeving does not allow of this course.

The list of defects following the statutory annual examination and testing, if maintenance has been carried out systematically, should be comparatively short.

Caisson Haulage Machinery

Owing to the vulnerable position which the caisson occupies in drydocking operations—particularly the sliding type which is drawn back into its own chamber—almost complete duplication of equipment should be installed to cover breakdowns, which if they occur at a critical period of docking, may endanger the incoming or outgoing vessel. The mechanical drive to the rope drums or chain sprocket wheels can be exempted with reasonable safety, as with actual operational time as low as thirty hours per year, wear and tear is negligible. Impact loading at start under slow speed and slack rope conditions is not greatly in excess of full load, except possibly when the caisson faces are new.

If considered necessary, further emergency measures can be designed to allow of the towing across of the caisson to the closed position by means of a capstan or heavy drydock crane, in which case the caisson would have to be cast adrift from the haulage machinery.

Electric motors and switchgear, idle for long periods, must be considered vulnerable in spite of the usual precautions against dampness. Duplication, with a mechanical changeover to the main drive is considered essential, as is the duplication of cable work from the pumping station. Failure of the electricity supply should be covered by the provision of a standby diesel generator referred to hereunder.

Maintenance is principally confined to equipment external to the machinery house. Driving ropes or chains frequently submerged during high tide conditions require constant attention, although it has been found economical to employ galvanised wire ropes in the former case. One advantage of the use of wire ropes as compared with pitch chains is the ease with which slack can be taken up. It is in the later stages of life when wear on the link pins accumulates rapidly difficulties are encountered. Rollers and sheaves either submerged or exposed to the elements require

Modern Dry Docks—continued

close attention, as do the final limit switches, which in the event of failure of the geared limit switches in the machinery house, will save the stalling of the driving motors.

It is recommended that the releasing shackle pins or the cross-head connecting pin on the caisson should be always in such a condition to allow of rapid slipping to cover the emergency referred to above.

Electrically driven wire rope operated caisson haulage machinery in the course of erection is shown in Fig. 7. Under high tide conditions the rope barrels are partially submerged and the motors are enclosed in a watertight compartment.

The mechanical arrangement provides for alternative drives by the 60 b.h.p., D.C. motors, the slow speed on the ends of the 100-ft. travel of the caisson being obtained by armature diversion. The mechanically driven slowing down and stopping limit switches are located on the steel frame under the main drive shaft.

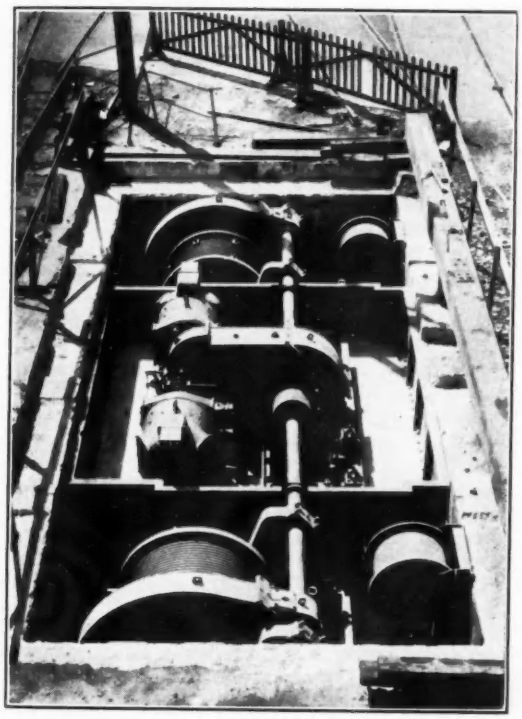


Fig. 7.

A completed A.C. equipment on similar lines, but at ground level, is shown in Fig. 8. In this case additional motors are required for the slow speed which are automatically brought in ad out of service by limit switches, which can be set to operate at any required position of travel. The operator with push button control immediately to hand has an uninterrupted view of the caisson throughout its travel. Steel joists are installed overhead for easy removal of motors or gearing.

In the matter of repairs to the caisson, and particularly during complete overhaul, the mechanical and electrical engineer must accept responsibility for the safety of the other trades working under conditions which may be electrically dangerous unless precautions are taken with tools, equipment and lighting. Apart from the provision of a suitable main transformer with a maximum of 110 volts and centre point connected to earth on the secondary side, V.I.R. flexibles must be constantly under surveillance particularly in regard to earthing connections.

Ancillary Services Equipment

Practice in the past in commercial undertakings has been for equipment ancillary to the actual pumping operations to be provided by individual units from the drydock side electric plug system. This is obviously uneconomical both in equipment and attendant manpower, and modern drydocks are being provided with centralised supplies of compressed air and electrical connections of suitable capacity and voltage for ships' installations, both D.C. and/or A.C. at 50 or 60 cycles, and welding.

This entails electrically driven compressors, motor generators, additional transformers and frequency changers making in all a considerable addition to the drydock ancillary equipment, which in the past has comprised diesel generator standby sets to cover failure of electricity supply; these being only of sufficient size to enable safety measures to be taken as regards closing of valves, caisson operation and dock draining.

Maintenance Staff: Spares and Recording

Drydock pumping stations are normally manned throughout the 24 hours and by virtue of the long periods when only auxiliary equipment is operating, the shift staff should have ample time to undertake day to day maintenance. Allocation of particular sections of the plant to each of the three shifts can produce considerable enthusiasm and results from the energetic, and a definite indication to the supervising engineer if and when enthusiasm is waning.

The degree of maintenance carried out by this staff must depend on port or yard conditions, but their close association with the plant whether running or stationary will form the main source from which log book defects are compiled for action by the maintenance staff.

In larger pumping stations it may be necessary to employ an electrician exclusively, but generally where there are a number of pumping stations, it is found practicable to pool resources of fitters, electricians, riggers and helpers specialising in this type of plant, and caisson hauling machinery.

Similarly in the case of drydock cranes the best results are obtained by the allocation of permanent crane drivers, who even though their scope of maintenance is limited to lubrication and oiling of wires when not actually driving, generally take a keen interest in the condition and operation of the cranes, and what is even more important, in the reporting of defects before they develop into serious troubles.

The group system of allocating maintenance can be employed where there are numbers of cranes in service and the advantages are even greater than in the case of running equipment. Close supervision is not practicable with scattered units and by this method responsibilities for the condition of the equipment can be pinpointed. In addition to and possibly because of this, records or normal maintenance, apart from breakdowns, will be more carefully kept by the staff concerned.

The method of undertaking maintenance requiring workshop facilities must depend primarily on the extent of the plant for which the mechanical and electrical engineer is responsible.

Normally the drydock installation will form part of a large organisation, in which case workshops will be available, either in the engineer's own department or in the near vicinity. Owing, however, to the delays which may occur by the placing of work, often of a specialised nature, outside the department, it is a sound policy to provide a fully equipped electrical shop with staff and tools capable of undertaking complete overhauls and re-winding when required.

On the other hand, it may not be economically sound to fully equip shops for purely mechanical repairs, unless there is sufficient work to keep a large proportion of the machines actively employed. The alternative is the provision of a fitting shop, heavy repairs being undertaken locally where facilities are available, or by the manufacturers.

The lack of accurate electrical instruments can cause much delay, both on site and in the repair shop, and it is considered that the outlay for a full set is a wise investment. In testing, primitive and inadequate instruments can lead to many false assumptions and conclusions, under conditions where a rapid and correct diagnosis is essential. Some discretion, however, should be used in the matter of staff who are permitted to use the more expensive instruments, particularly on site where connections may be somewhat confused.

Detail drawings of all main items and electrical diagrams called

Modern Dry Docks—continued

for in specification should be carefully recorded and should be available at all times.

Provision of Reserve Equipment

The quantities of spare parts which should be held to allow of the minimum delay when breakdowns occur, will depend on the type of equipment.

In the case of the pumping plant a reserve unit is generally installed which allows of one major overhaul or repair. Even if this is not so and it is perforce found necessary to increase the time taken in dewatering, although some delay and inconvenience may be caused, the operation can still proceed. In point of fact, the time lost may be quite a small proportion of the total dewatering period, as the rate of pumping is normally reduced immediately before the vessel sits on the drydock keel blocks, and continues at this reduced rate to permit the scrubbing down of the hull from flats. Because of this, the holding of quantities

Fig. 8.

of expensive spares for the main dewatering pumps and motors is not considered necessary.

With higher speed auxiliary pumps, frequently running continuously for long periods, the safe time available for overhaul or major repair is reduced, and in such cases it is advisable to stock a spare impeller and cheek plates for each size of pump and perhaps at a later stage in the life of the plant, spare pumps complete.

As indicated previously, switch and control gear installed and operated under reasonable conditions need few replacements, and spare contacts, operating coils of each type, ballast resistances and flexible tails would cover normal requirements.

With drydock cranes, in view of the possibility of the complete immobility of the whole unit by the failure of a small component part, with repercussions to the ship repairing programme, it is a wise policy not to be too restrictive in the stocking of spare parts. Although, as recorded earlier, the life of drydock crane ropes is frequently long, inadvertent damage in operation may occur and therefore a stock covering all lengths, sizes and construction should be maintained.

As regards the motors, if full electrical workshop facilities are readily available, spare parts, particularly of armatures and rotors can be reduced. In the matter of partial rewinding, much time can be saved by the holding of a few completed coils for each size and type of motor. The exact size of copper is frequently difficult to obtain locally and in any case the setting up of the coil winding machine and taping utilises valuable time which, when a breakdown occurs is vital. For control gear, if some degree of standardisation has been followed throughout the dock or yard crane installations, coils, contactor and brake, and resistance units should be available and therefore no individual stocking for the drydock plant should be necessary.

Normal spares should suffice for caisson haulage machinery, since the electrical drive is duplicated and the time factor is not vital. It is advisable, to cover accidental damage, to hold suitable lengths of rope or a number of chain links.

Records

Experience has shown that a card index system giving details of the main units, on which is entered only the really relevant facts in their history, is more valuable for reference than such a system in which every minor detail of maintenance throughout is carefully recorded.

The history card of the main units should give briefly full particulars of the plant and in addition special details for which the engineer is so frequently asked during its life.

Date of acceptance, price, and outline drawing numbers are common to all types of plant, but much time can be saved if such information as the following is immediately available without recourse to correspondence or specifications:

Pumping Plant

Heights of suction and maximum discharge.
Capacity in tons per minute.
K.V.A. input.

Cranes

Maximum outreach of whip hoist and/or jigger hoist.
Crane rail span. Type of travelling wheels.
Length of crane track.
Distance of waterside rail to drydock edge.
Types, sizes and lengths of wire ropes.

Caisson

Maximum distance travelled—speed of travel fast and slow.
Time taken for complete opening and closing operation.
Pull in tons on ropes or chains—maximum and minimum.

In addition, with new equipment it is essential to record the full details of all component parts which can be identified from the various name plates. This information will be of the greatest service when ordering spares, but it can be kept separate from the main history card and referred to only when the occasion arises.

Details of routine maintenance should be recorded, but provided defects have been noted for further investigation and action, there appears to be no advantage in their prolonged retention. The value of a system in which forms in triplicate or quadruplicate are distributed to various pigeon holes appears to be more theoretical than practical.

The operational history which follows on the record card should include such information as main items of maintenance with full details of work undertaken and spares utilised, breakdowns, times out of service, rope replacements on cranes and caissons etc. all these being in such a category as to provide the engineer with solid information without confusing details of minor importance.

Conclusion

It will be seen from the foregoing that much may be done to prevent major repairs and shut down of plant—accidents excepted—if the following means are adopted:

(a) The closest association of the mechanical and electrical engineer from the specification stage onwards.
(b) Regular inspections during its life.
(c) Accurate reporting of unusual behaviour by regular operators.
(d) Not procrastinating over or 'temporarily fixing' even minor repairs.
(e) The employment of specialist rather than 'all-round' maintenance staff.

The question of the cost of maintenance will inevitably arise, but when it is considered that the mechanical and electrical engineer may have under his care, live drydock equipment to the value of four or five hundred thousand pounds in the larger installations, with a life which can be extended to 50 years and over if properly nurtured, this matter should be regarded in true perspective.

The author wishes to thank the British Transport Commission for permission to publish the photographs.

United Kingdom Inland Waterways

Summary of Report of Committee of Inquiry

The Report of the Committee of Inquiry into Inland Waterways was published on July 28th (H.M. Stationery Office, price 6s. 6d. net). The Committee was appointed by the Minister of Transport and Civil Aviation in February, 1956, under the chairmanship of Mr. H. Leslie Bowes, C.B.E., to consider and make recommendations covering:

the maximum use of the country's system of inland waterways;
how waterways which cannot economically be maintained for transport, but which are useful for other purposes, should be administered and financed;
conversion of canal sites to other purposes where desirable and practicable;
the law relating to the closing of waterways to navigation.

The Navigable System

The Committee recommend that about 1,300 miles of inland waterways in England, now vested in the British Transport Commission, should be made an integrated and efficient system of inland navigation. They divided the system into 380 miles of class "A" waterways and 930 miles of class " B " waterways.

Class "A" Waterways, taken together, currently earn a surplus over working expenses. Most of them are being improved under the Commission's £5½ million programme for the waterways, and these improvements should go forward. The Committee believe that class "A" waterways will pay their way, but any surplus must be devoted to maintaining them to a high standard and continuing to improve them as necessary, and not diverted to the support of other waterways.

Class " B " Waterways, mainly " narrow " canals, should be restored over 5 years to the widths and depths which will enable the largest craft built for use upon them to navigate safely with full payloads. The revenues from all sources, including navigation fall short of working expenses by about £300,000 yearly.

Encouragement of Transport on Class " B " Waterways

The Committee consider that the main handicap to use of these waterways for commercial carriage is the low utilisation factor of small craft operating on narrow canals, with many locks and often circuitous routes. They recommend that deterrents to enterprise in the carrying industry should be removed and encouragement given by:

(a) the reinstatement of these waterways, mentioned above;
(b) removing existing doubt and insecurity by a commitment to maintain the navigable system to prescribed standards for twenty-five years;
(c) abolishing the existing system of tolls (at present levied per ton of goods carried, varying from one kind of goods to another, and from waterway to waterway) and substituting an annual licence-fee per vessel. This, they suggest, should be £1 per ton of capacity, representing about £25 per year for a " narrow boat." The licence system should extend to vessels carrying up to 60 tons, and a licensed vessel should be entitled to carry on any Class " B " waterway without further charge.

Non-transport Uses and Revenue

Water abstraction is extremely important. The Commission's waterways (including those in Scotland) supply 205,000 million gallons yearly, besides unrecorded abstractions which cannot be estimated. This use is increasing with industry's growing demand for water. But the powers to obtain and to supply water are derived from old canal Acts and often do not enable this function to be developed, or economic charges to be made for supplies. The Committee recommend that the development of non-potable supplies from canal should be undertaken in the interests of the waterways and because of their valuable contribution to national water resources; also that the responsible Ministers and the canal owners should jointly survey these water resources and prepare a scheme for their greater utilisation.

Reception of effluents and surface water is also an important use of the waterways. Little revenue is earned from it, but the Committee recommend that it should be put on a contractual basis.

Of the **recreational uses,** angling and pleasure boating are particularly important numerically. Revenue from them, though likely to increase, is not great—about £7,800 yearly from angling and £20,000 yearly from pleasure boating. Thus, even a substantial increase would produce no great improvement in the waterways' finances.

Towing paths (where not already public rights of way) should be open to the public as footways, free of charge, so far as consistent with the needs of navigation; but there should be a power to suspend such use in the interests of other uses of the waterway.

Finance

The Committee think that class " B " waterways will continue to incur deficits of the order of £300,000 yearly, and the proposed substitution of licence fees for tolls would result in a further loss of revenue (though they point out that, with tolls at their present level, traffic receipts are declining, and likely to continue to do so). If their proposals were accepted, they estimate a deficit of about £½ million annually, and the measures to reinstate these waterways, recommended by the Committee, have been conservatively estimated to cost £3½ million. They consider that funds will have to be found to meet these expenses, either by direct payments from the Exchequer or by some other means. They point out that the deficits which these waterways incur is a burden which is being borne by the community now, although it is not generally realised, and that a further decline in use for navigation will not lessen the burden.

Carrying Activities of British Waterways

The carrying fleet operated by British Waterways should, in the Committee's view, continue its activities on the same terms as the Commission's other carrying operations, i.e., without special financial support.

Administration

The Committee are unanimous in their recommendations as to practical measures to be taken. They differ over the body to whom the administration of nationalised waterways, and the carrying out of the recommended measures should be entrusted. The Chairman and three other members recommend that the nationalised waterways should continue to vest in and be administered by the British Transport Commission, but that the Commission should delegate substantial powers to a statutorily constituted body, to consist of three members of the Commission and four other members, drawn from general industry, to be nominated by the Minister. This body should manage the nationalised waterways within the framework of general policy laid down by the Commission.

Four other members of the Committee recommended instead that the nationalised inland waterways should be transferred from the British Transport Commission to a new, independent Inland Waterways Corporation, to be set up by statute and to consist of nine Government-appointed directors, including three part-time ones chosen for their knowledge and experience of local government, water supply, land drainage and other non-transport uses of the waterways, and one part-time member to represent Scottish interests. The other five directors would be full-time. The Corporation should take over British Waterways' existing undertakings, organisation and staff. The Class "A" waterways should be self-supporting and the carrying services should also be run on a self-financing commercial basis. The Corporation should be responsible to the Minister of Transport and Civil Aviation, through whom its annual estimates should be submitted. Its deficits should be met from the Exchequer.

Re-development and Elimination

The Committee make no specific proposals for dealing with particular waterways which they have not recommended for inclusion in the navigable system. They point out that some hundreds of miles will need to be reviewed case by case, and a fresh assessment made of their value to the community. They propose a new machinery for reviewing these " problem " water-

United Kingdom Inland Waterways—continued

ways individually and preparing schemes for their future use, and they suggest principles by which this review should be guided.

In this matter, again, the Committee are at one about the needs and objectives, but they differ on procedure. The members who favour retention of nationalised waterways by the British Transport Commission recommend that the Minister should appoint an independent Waterways Re-development Board, including members with experience of commerce, finance, agriculture, land drainage, local government, water supply and the amenity and recreational aspects of waterways, to review the nationalised waterways not included in the navigable system.

The British Transport Commission should apply to the Board to prepare a scheme for the re-development or elimination of any nationalised waterway not included in the navigable system. The Board should have discretion to prepare a scheme themselves, or to require the Commission to prepare one and submit it to the Board.

Schemes could provide for keeping a waterway, or part of it, in being as a water-channel, for purposes other than navigation for transferring it to any person or body who could make use of it; for restoring it for navigation; for de-watering it and filling it in; for disposing of the site and buildings; and for modifying or abolishing any special obligations standing in the way of the most useful and practicable treatment of the waterway. There should be publication of schemes and provision for the consideration of objections.

Compensation should be payable for interference with valuable private rights, actively and lawfully enjoyed, which are affected by a scheme. The amount of compensation should be determined, in case of dispute, by the Lands Tribunal.

If British Transport Commission made no application to have a scheme prepared for a particular waterway, but other interests (public authorities, owners of adjoining land or bodies representing users of the waterway) wished a scheme to be prepared, they should be entitled to apply to the Minister of Transport and Civil Aviation to make an order referring the waterway to the Waterways Re-development Board for review.

Those members of the Committee who recommend that the nationalised waterways should be transferred to an independent Inland Waterways Corporation see no need for a separate Waterways Re-development Board, but consider that the Corporation itself should prepare and negotiate schemes instead. To enlist the co-operation of various interests, they propose the constitution of a Re-development Consultative Committee, at local level, to assist in the preparation of each scheme.

Nationalised Waterways in Scotland

The Caledonian and Crinan canals should be kept in being as navigations. Neither is expected to become a viable, commercial undertaking, but they play an important part in the social and economic life of western and north-western Scotland, and may in time become more important for transport. The Crinan Canal should be improved.

The Monkland Canal has been legally abandoned for some years and the Edinburgh and Glasgow Union Canal carries no commercial traffic, but both are suppliers of water. The Forth and Clyde canal is used by fishing vessels moving from coast to coast, and also by yachts. Transport of merchandise on the canal, however, is very small and confined to very short movements at either end. The Committee see no prospects of a revival of goods transport, and the canal, besides operating at a large and continuing deficit, is burdensome to the community in other respects. They conclude that, on balance, it would be best to close the canal to navigation, but keep it in being as a water channel. .

The working deficits of the two Highland canals and the cost of improving the Crinan Canal should be borne by the State, as before they were vested in the British Transport Commission. The other three canals should be reviewed through the re-development procedure, and schemes for them prepared (in Scotland, the Secretary of State should be the confirming authority for schemes).

Independent Inland Waterways

The Committee do not recommend that any inland waterway which is now owned and managed otherwise than by the British Transport Commission, should be nationalised. In case circumstances arise in which it would be expedient to incorporate an independent waterway in the national navigable system, the British Transport Commission (or the proposed Inland Waterways Corporation) should have power to acquire it by agreement with its owners.

Owners of such waterways should be enabled to obtain, by order made by the Minister of Housing and Local Government, powers in respect of water abstraction and reception of effluent and surface water similar to those proposed for nationalised waterways. Independent waterways which are disused for navigation, or derelict, should be referred to the Waterways Re-development Board if the Minister of Transport and Civil Aviation so orders, on the application of the owners, or of other interested authorities or persons, so that schemes can be made for them.

The Broads

The Committee recommend that, in the case of the Norfolk and Suffolk Broads, the work of dredging and re-instatement, now being carried out by the Great Yarmouth Port and Haven Commissioners, should go forward. The Commissioners, however, should be given wider powers and greater revenues. They should be empowered to charge higher tolls, particularly for pleasure craft let out on hire; and also to precept upon the counties of Norfolk and East Suffolk and the county boroughs of Norwich and Great Yarmouth, up to the limit of a penny rate. The Commissioners should have adequate powers to control the use of the rivers and broads, do works for their preservation and improvement, provide facilities for their enjoyment, secure access to them, and extend their jurisdiction to broads and sections of waterway now outside it, in order to open them to navigation. Boat owners, and the county and county borough councils mentioned, should be represented on the Commission, and representation of the Nature Conservancy and the National Parks Commission should also be considered.

The Committee point out that the demand for the use and development now of the rivers and broads is greater than ever, and recommend that legislation to implement their recommendations should be introduced at an early date.

Major Improvements

The Committee interpret their terms of reference as concerning the existing system of inland waterways, but they recommend that technical and economic investigations should be put in hand to assess the value of:

(i) making the Grand Union Canal navigable by 90-ton craft between Birmingham and the Port of London without transhipment; and

(ii) making a new waterway, usable by large craft, to link the Mersey, via the Weaver, with a terminal near Wolverhampton.

Recommendations as to Changes in the Law

The Committee consider that the mass of special Acts, some going back to the 18th century, under which the nationalised canals are now administered, should be swept away, and replaced by a modern code of rights and duties, fashioned to meet present-day conditions.

Development of Free Port for Hungary

Plans are in hand to restore to its pre-war status the free port of Csepel, on the Danube in Budapest. Repair work has now been completed on the port, which was badly damaged during the last war, and more than 3,500 sq. yds. of warehouse space is being offered to foreign firms with the aim of developing the area as an important east-west transit port. Swiss, West German and Italian transport firms have already asked for tenders for leases and, should foreign demands exceed the existing accommodation, the area will be extended.

The Demolition of Ripple Rocks

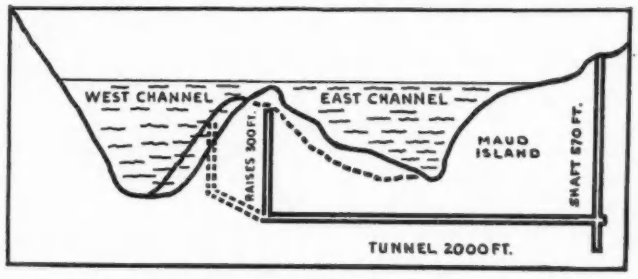
Canadian Shipping Lane freed from Obstruction

During past years there have been many suggestions as to how best to remove two dangerous rock peaks lying in the Seymour Narrows between British Columbia and Vancouver, Canada. These have always been a dangerous hazard to shipping using the channel and have caused the loss of some 114 lives and 24 ships, as well as over 100 smaller craft. Two previous attempts have been made to remove the peaks using explosives dropped from barges anchored above them, but both failed.

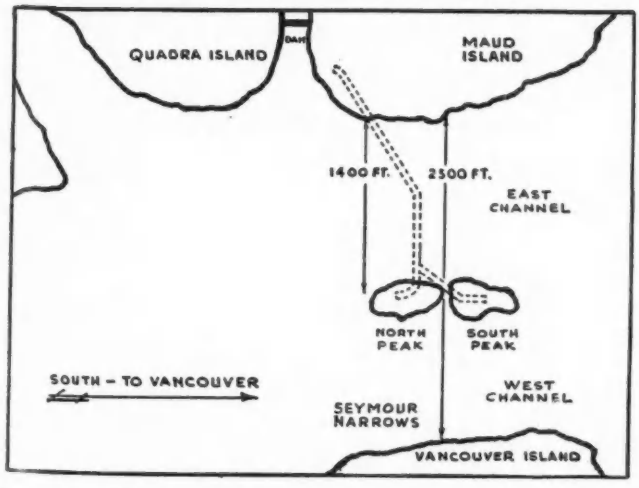
The Ripple Rocks are situated some 100 miles north of Vancouver and the two peaks reached to within 9-ft. and 20-ft. of the surface at low water. They were broad, rounded hump-like summits of volcanic rock, 3,000-ft. long and 1,500-ft. wide at base, rising from 325-ft. to 400-ft. above the sea bottom. The passage was only safely navigable during the 20 to 40 minutes of slack tide twice a day.

On April 5th last, a $3 million engineering project to remove the high peaks of the ridge was successfully completed when 1,400 tons of high explosive were detonated. As a result of the operation, the peaks have been lowered to a level of 47-ft. below the surface at low tide.

Work on the project was started in November 1955, and extensive underground excavation was necessary to gain access to the critical elevations within each rock for the placing of the explosives. Diamond drill exploration showed that it was possible to drive the shafts into the rock, and work commenced with the sinking on Maud Island of a 7-ft. by 18-ft. three-compartment shaft with cage, skip and manway compartments, to a depth of 570-ft. Approximately 2,400-ft. of tunnel, 6-ft. by 7-ft., was driven from the shaft to a position under the North rock, and



Drawings showing the tunnel plan adopted.



forking to the South rock, maintaining a minimum of 100-ft. of ground under the deepest part of the channel. Two 7-ft. by 15-ft. access raises or sub-shafts were driven upwards for a height of 300-ft. from the tunnel level to within about 40-ft. of each summit. A station was cut in each sub-shaft at 120-ft. elevation below extreme low tide, from which a 5-ft. by 6-ft. sub-level was driven north and south along the long axis of each rock for approximately 250-ft.

From each sub-level drift, exploratory holes were drilled at intervals in a fan-shaped pattern to check the outer contours of the rocks. These had previously been plotted by the hydrographic service of the Department of Transport, by means of

A spectacular photograph of the explosion.

echo sounding. With this accurate pattern of the contours, it was possible to lay out a system of "coyote" tunnels, designed to break and disperse the rock to the desired level. The next step required driving service shafts to the levels of the proposed system. Excavation on the tunnels could then start and the spoil was dispersed to the sub-level through these openings. The coyote tunnels or drifts were used as chambers into which the explosives for the final blast were stacked.

During the mining operation special precautions were taken to ensure the protection of personnel and workings at all stages of the project. All headings were preceded by test drilling to discover abnormalities of ground and water flows. In the tunnel, two holes were maintained a minimum of 100-ft. ahead of the face at all times. One of these was cored to provide evidence of the nature of the ground. Protection from flooding was ensured by the installation of emergency pumping equipment, and steel emergency doors designed to close on any abnormal flow of water. Prior to the detonation an area within 3 miles of the explosion was designated as an evacuation zone.

Seismographic stations in Western Canada measured the effect of the blast and their records will form part of Canada's contribution to the International Geophysical Year. The explosion should have provided valuable information on the formation of the earth's crust.

New Lightweight Container

To overcome the problem of supplying containers which are of sufficient light weight to provide a maximum payload and yet are strong enough to withstand usage under all conditions of service, the Northern Aluminium Co., Ltd., in conjunction with Messrs. Saunders-Roe (Anglesey), Ltd., has developed a new container designed to meet the operating conditions of British Railways, with which it is at present in experimental service, bearing in mind the wider aspects of transhipment by road and sea. The overall height allows for shipment as 'tween-deck cargo in the majority of vessels. The container can also be handled by a fork-lift truck, and sufficient strength has been embodied in the design to permit stacking if required. With the exception of the welded-steel strengthening framework in the floor and roof, the container, which has a capacity of 500 cu. ft., is of aluminium-alloy construction. It can carry a payload of five tons on the floor or hanging from the roof, and has an overall length of 12-ft. 6-in., a width of 7-ft. and an overall height of 7-ft. 4-in.

Flag of Convenience Ships

American and British Views Contrasted

(By a Special Correspondent)

Across the Atlantic, American shipowners and their supporters have vigorously defended the operation of U.S.A. ships under "flags of convenience." Registration in "Panhonlib" countries, indeed, is countenanced, even encouraged, by the administration on the plea that only in this way (because of the high cost of operating American ships) can the U.S.A. maintain a merchant fleet, necessary both on strategic and commercial grounds.

Recently Mr. Erling D. Naess came to London to discuss with newspaper correspondents this question of flags of convenience or, as he preferred to call them, "flags of necessity." Mr. Naess is a Norwegian who adopted American nationality. His firm is the Naess Shipping Co., Inc., of New York, and while emphasising that he spoke only for himself, he said he knew that his views were shared by all other American owners of ships flying Panamanian and Liberian flags.

He disclosed that about a half of the American-controlled tanker fleet of approximately 12 m. tons deadweight is under the flags of Panama, Liberia and Honduras, whose combined tanker fleets aggregate about 13 m. d.w.t. Of the remaining 7 m. tons of Panhonlib tanker tonnage which is not American-owned, a substantial proportion—precisely what proportion it was difficult to say—has been American-financed and is controlled in the main by Greeks and Italians. In addition, about 8 m. of the 33 m. d.w.t. tankers now under construction or on order throughout the world are for American owners who will register them under flags of convenience.

The key question, said Mr. Naess was: Why have American owners and financial institutions gone to such lengths to create such a huge fleet of tankers under these flags. The answer was to be found by considering America's stake in and dependence on the international oil industry. Before the Second World War, American domestic oil companies accounted for over two-thirds of the crude oil output outside Soviet Russia. To-day the U.S. share of world output was under 50 per cent.

But America is still by far the greatest market for oil products, and the influence of U.S. supply and demand is still predominant in world markets. Whilst before the war America was a net exporter of oil products, now she is a net importer and is becoming dependent, to an increasing extent, on oversea supplies and, therefore, on the tankers to carry it not only to the United States but to markets throughout the world, for the American oil industry has interests in practically all producing and consuming countries.

Mr. Naess now comes to the crux of the matter. How, he asked, can American-flag tankers, owned by or chartered to American oil companies, compete with their European rivals whose operating costs are so much lower? Moreover, considering America's increasing dependence on imported oil—in 1957 alone, imports into the United States accounted for more than 20 per cent. of the oil in international trade—it is essential that she should have at her command in wartime an adequate amount of tanker tonnage, at least 10.5 m. d.w.t. according to the most recent estimate.

A fleet of this magnitude could not be conjured "out of a hat" in the event of another international conflict which, unfortunately, could not altogether be ruled out. Therefore, for defence reasons alone—quite apart from reasons associated with normal trading—it was essential that the United States had at its disposal at all times a substantial tanker fleet.

Mr. Naess then discussed the two alternatives: to operate American-flag tankers under the American flag and heavily subsidise them, or to place them under the flags of countries closely associated with the United States. To subsidise tankers would impose a heavy financial burden on the United States taxpayer who is already heavily burdened with taxes to pay for United States military and economic aid to overseas countries, as well as to pay for the numerous other projects inevitably associated with a modern community. Recourse to flags of convenience was the only other course and that was why a fleet of American tankers was now operating under the Panamanian, Liberian and Honduras flags, some owned by the oil companies themselves, and others by independent companies with their ships chartered to the United States oil companies.

Mr. Naess defended the action of United States financial institutions in financing tanker tonnage for foreign-flag operation.

He suggested that it was somewhat rash and presumptious for British interests to criticise American institutions for financing both American and non-American shipowners when if Mr. Nigel Birch (a former Economic Secretary to the Treasury) was correct they had not taken full advantage of the facilities which were available on their own doorstep.

Finally, on the subject of taxation which, according to most British shipowners and their supporters, said Mr. Naess, was at the root of all British maritime troubles, surely it was up to the British Government to put the matter right. Foreigners could hardly be blamed for the level of British taxation. It had also been said that taxation in Liberia, Panama and Honduras was too low and that, if it were higher, foreign shipowning corporations would not fine these countries so attractive. What right had Europeans to criticise—let alone seek to determine—taxation levels in non-European countries? Furthermore, assuming that foreign owners found the tax position in those countries conducive to successful ship operation, what right had Europeans to criticise them for availing themselves of it?

The position of the United States operators under flags of convenience was identical to that of British shipowners establishing companies in Bermuda. If it could be shown that taxes on shipping in Britain were still so heavy as to make her competitive position difficult and that the formation of companies in Bermuda did not provide the solution, surely it was a matter for the British owners to take up with their Government. "I am sure," was Mr. Naess's Parthan shaft, "that efforts in this direction would be more productive and beneficial than maligning the competition."

The British Viewpoint

The General Council of British Shipping has submitted to the Minister of Transport a memorandum on flags of convenience. This has not been made public, but sufficient is known of the view of the British shipping industry to be able to represent that view. In the first place, shipowners in the United Kingdom recognise the need for the United States to possess a merchant fleet adequate for its purposes. But why, they ask, go about the matter in such a way as to be harmful to the traditional maritime countries to whom a mercantile marine is at least as important as it is to America—in some cases even more essential?

America has not so many friends and potential allies in Europe that she could contemplate the weakening and impoverishment of them through her own actions without realising all that would be entailed. British shipping contributes something in the neighbourhood of £300 m. a year to the national balance of trade; Norwegian shipping is almost the only export industry that country possesses. If the merchant fleets of these two nations alone were seriously reduced and their earning power drastically cut through unfair competition, the repercussions would be serious.

Admittedly the solution of the problem of flag-of-convenience competition lies in the field of taxation, but there are other principles at stake. America may be able to exercise responsibility for and justification over the ships she permits to register in other countries, but it does not follow that other nations will be able to do so. The law of the sea is not maintained and has certainly not been established by Panhonlib countries.

Competition in international shipping, as the Liverpool Steam Ship Owners' Association state in their last annual report, has in the past in the main been on a basis of reasonable equality and, as such, British shipping has met it on its own merits and has been able and willing to do so. Given a fair field of economic equality, it has never complained or been fearful of the outcome. The novel competition of the so-called "flags of con-

Flag of Convenience Ships—continued

venience" which has emerged and increased in startling manner in the post-war years is of a different character altogether.

If, adds the report, taxation and inflation continue in the United Kingdom on the present scale, the British mercantile marine cannot hope indefinitely to survive against the competition of shipping, the earnings of which are not subjected to tax. Incredible though it may sound, it is none the less the fact that Liberia—a country with virtually no overseas trade of its own and with a population no greater than that of Liverpool and Manchester combined—has, in the space of less than ten years, become the fourth largest shipowning country in the world.

What must be sought, insists the Chamber of Shipping of the United Kingdom in its report, is a solution which will provide an effective means of adjusting the competitive balance between Panhonlib operators and those of other countries. The present disparity is to give Panhonlib overwhelming advantages over their competitors, one of the chief of these undoubtedly being the ready access to finance for the expansion of their fleets which their virtual tax immunity gives them.

Not the least remarkable aspect of the matter is the way in which seafarers support shipowners. Indeed, they would go much farther than at any rate United Kingdom shipowners would agree. The International Transport Workers' Federation has on occasion in the past suggested drastic steps to meet this problem of flags of convenience—to which they give descriptions much less polite. Now they threaten boycott of those vessels for which there is no collective agreement as recognised by the Federation, and Mr. Tim O'Leary, of the Transport and General Workers' Union, and Mr. Tom Yates, the secretary of the National Union of Seamen, have been asked to plan the necessary measures. The appointment of these leaders of United Kingdom dockers and seamen as alternate chairmen of the Federation's International Fair Practices Committee brings this country right into the arena.

Report on Port Churchill, Hudson Bay

The Seventeenth Report on Hudson Bay Marine Insurance Rates, 1958, states that in accordance with their terms of reference, the Commonwealth Shipping Committee have again examined the conditions affecting ships trading to Port Churchill, Canada.

A total of 46 ships made commercial voyages to Port Churchill and loaded full cargoes of grain in 1957. Although the number of ships was two less than the previous year's record, many of the ships were larger, with the result that there was an increase in the amount of grain shipped, which, at 16,577,000 bushels, constituted a record. The port again handled a heavy volume of shipping and cargo in a satisfactory manner with turn-round times averaging 3.75 days for all ships, compared with 3.9 days in 1956.

The navigation season opened on the 23rd July for ships passing Cape Chidley and closed on the 15th October. Unusually severe ice conditions prevailed at the eastern end of the Hudson Strait, however, at the beginning of the season. Ice, which was distributed over the whole of the Strait, together with a thirty mile wide ice belt through which the early ships had to pass, caused an abnormal number of casualties. In all, ten ships sustained ice damage ranging in extent from chipping of propeller blades to tearing away of bow plating.

Sixteen aerial ice surveys were made by the Canadian authorities between the 19th July and the 5th September covering the route from Port Churchill, through Hudson Bay and Strait to Resolution Island, and Masters were given advice about which courses to follow. The Canadian authorities are undertaking similar aerial surveys during the 1958 season.

The Committee refer at some length to a report of the National Research Council of Canada. This report, the fifth and final one, analyses ice formations noted visually and with radar equipment by Masters using the route in the 1957 season, and surveys the information so acquired over the five-year period from 1953 to 1957. The Council report on the limits of the ice hazard and state that the maximum ice concentration is located in a 450 mile section of the Hudson Strait route, but the amount a ship will encounter in that area will be 50 per cent less in the second half of the season than in the first half. Reports on radar detection of all formations have established the dangerous types of ice and the fact that sea-clutter in excess of 1,000 yards is present most of the time. The Council state that radar is a definite asset in ice navigation provided it is operated with an appreciation of its limitations in detecting small targets in sea-clutter and they recommend short ranges, under 10,000 yards, for the detection and tracking of dangerous ice such as bergy bits and growlers.

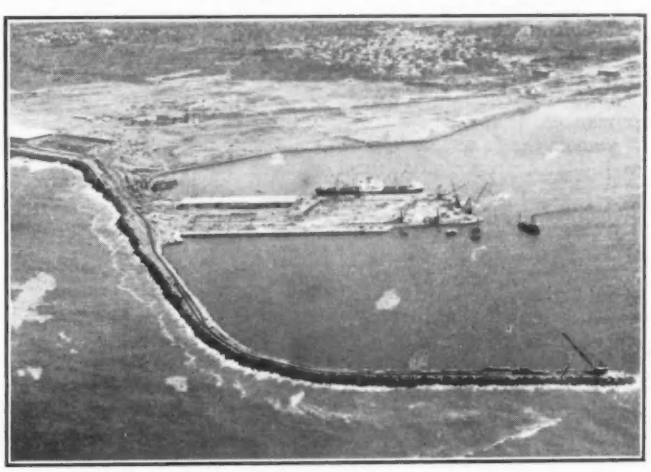
The Canadian authorities stress the desirability for all Masters to keep the Ice Information Officer at Churchill informed of their movements from the time they enter the Hudson Strait and they recommend that, when traversing the Hudson Strait and Hudson Bay, Masters should keep a continuous watch on the regular radio schedule and when the aerial survey plane circles the ship.

The Report, which is entitled "Seventeenth Report on Hudson Bay Marine Insurance Rates, 1958," is on sale at H.M. Stationery Offices, price 1s. net.

The Port of Tema

First Ocean-going Ship Enters New Harbour

On Monday, July 14th, 1958, the Elder Dempster cargo liner the M.S. "Oti" 8,000 tons dead weight berthed at Tema Harbour, Ghana. The vessel was the first ocean going ship to enter the harbour which is still under construction and which, when completed will be the largest artificial harbour in Africa.



Aerial view of Tema Harbour, showing M.S. "Oti" berthed alongside new quay and, in foreground, breakwater still under construction.

The construction of this £12 million project is being carried out by Parkinson Howard Ltd. (in association with Sir Lindsay Parkinson & Co., Ltd., and John Howard & Co., Ltd.). The contract was awarded in 1954 and is due to be completed in 1960. The consulting engineers are Sir William Halcrow & Partners.

The breakwaters of the harbour which are designed to give protection to an area of 500 acres and provide safe anchorage in 42-ft. depth of water, will have a total length of 3 miles. Their construction has involved the quarrying of over 5 million tons of rock in blocks weighing up to 12 tons.

The four-berth Quay, Dockyard, Oil Berth, Fishing Harbour and Slipways form part of the facilities within the harbour proper, and the facilities on shore include 20 miles of rail sidings, transit sheds and a 100-ft. lighthouse. There are two Cocoa sheds with a 180-ft. clear span, which are the largest clear span buildings yet constructed outside the U.S.A. and these are rapidly approaching completion.

The Problem of Unofficial Strikes

Traders and the London Dock Dispute

(From an Industrial Correspondent)

The Minister of Labour has put the number of man-days lost as a result of the recent unofficial strike at the London docks at 330,000 and has stated that it was probably as serious a strike as has been experienced in this country for the past ten years. Its seriousness was emphasised by the fact that a reputation from the London Chamber of Commerce waited upon the Minister to inform him of the effects of stoppages in the London docks on users of the port and on the interests of members of the Chamber. The deputation consisted of Lord Ebbisham, the president, Mr. Allen L. Stock, the deputy chairman, Mr. R. L. Wills and Mr. A. de V. Leigh, the secretary.

Some concern has been aroused by statements by foreign shipowners that they will discontinue using London because of the frequency of stoppages, and will divert their vessels to other ports. This was conveyed to the Minister, who was also told that there was a danger that foreign countries would give their orders for goods elsewhere because of delivery delays brought about by dock strikes.

In the current issue of the Chamber's "Journal" it is stated: "Clearly the best solution would be to find some means of eliminating the unofficial strike, but until such time as the dockworkers show a sense of responsibility and intelligent discipline the immediate need is to mitigate the disastrous effect of such stoppages. For this purpose probably the first essential is to enable unregistered labour to be used for the removal of goods from warehouse or wharf and for the handling of at least perishable cargoes."

The "Journal" went on to say that the Dock Labour Scheme has provisions which permit the port and National Dock Labour Board to sanction the employment of unregistered labour in the event of unofficial stoppages, but in practice they are inoperative. It should be mandatory for permission to be given in such circumstances.

"One of the functions of the Dock Labour Board is to 'ensure the full and proper utilisation of dock labour for the purpose of facilitating the rapid and economic turn-round of vessels and the speedy transit of goods through the port.' The situation demands that steps should now be taken to ensure that this result is achieved in the future without interruption."

There was an immediate reaction to this proposal from Mr. Tim O'Leary, the national docks officer of the Transport and General Workers' Union. Whatever unregistered labour was called, he said, it would be "black" labour as far as the union was concerned. Everybody, he added, regretted wild-cat strikes of any kind. The nature of the docks industry was such that these could happen there more easily than anywhere else. But the one sure way to dislocate the ports of Great Britain would be to adopt this suggestion to introduce unregistered or non-union labour and he felt that the Minister of Transport was too wise to be stampeded into such a futile step.

It is clear from answers given by the Minister of Labour to questions put to him in the House of Commons that he is not contemplating any radical amendment to the Dock Labour Scheme, although there are certain aspects of it which he has under consideration. He pointed out that unofficial strikes are a most serious problem and from their nature are difficult to resolve by normal methods. Few, if any, of the suggestions put forward for lessening the risks of strikes have much relevance to unofficial strikes where the main responsibility for avoiding them rests on the trade unions themselves.

Mr. Norman Pannell, the Conservative member for Kirkdale, said that these irresponsible, unofficial dock strikes which are so damaging to the country's economy, are symptomatic of a deep malaise in industry and call for urgent discussions between representatives of the employers and the trade unions with a view to amending the Dock Labour Scheme.

The Minister agreed that unofficial strikes are a curse to industry and disruptive of the authority of the trade unions. But there had been a considerable period of peace in dockland before this strike. He also agreed with Mr. Alfred Robens, Labour member for Blyth, that there was adequate machinery, within the present scheme, for consultation between employers and trade unions. Trade union officials in all these cases had worked with the Minister to bring peace in the industry and themselves were very much against unofficial strikes. While this is true, the Minister pointed out that it was also true that the efforts these unions made in the long dispute failed.

Revised British Standards for Wire Rope Fittings

The British Standards Institution has recently published six revised British Standards for wire rope fittings. The scope of each of these publications is briefly summarised below.

B.S.461 "Bordeaux connections." This 20-page standard specifies the dimensions, materials and inspection, testing and certification requirements for the bordeaux connection fittings used for attaching wire rope to short link chain. The safe working load of the Bordeaux connections is to be between 1 ton 8 cwt. and 10 tons 10 cwt. The specified sizes of wire rope range from ½-in. to 1.3/8-in. diameter.

One of the standard's three appendices deals with "splicing a Bordeaux connection with a wire rope." There are fully annotated illustrations of a Bordeaux connection and a higher tensile steel grab shackle.

B.S.462 "Bull dog grips." This 16-page standard specifies materials and dimensions for the fittings named bull dog grips, used to secure the end of wire rope as an alternative to splicing or socketing (e.g. in the absence of skilled labour or other facilities for such work). The range of nominal sizes is 5/16-in. to 2.1/4-in.

An appendix to the standard deals with a method of applying bull dog grips to wire rope. There are illustrations showing the correct and the incorrect method.

B.S.463 "Drop-forged sockets for wire ropes for engineering purposes." This 18-page standard specifies materials and sizes for drop-forged sockets of the open or closed types, for wire ropes of 5/16-in. to 1.5/8-in. diameter. One of the standard's two appendices gives a recommended method of hot white metal socketing. The dimensional tables for open type sockets and closed type sockets are shown with annotated diagrams.

B.S.464 "Thimbles for wire ropes." This 18-page standard specifies materials and dimensions for thimbles for wire ropes of nominal sizes from 5/16-in. to 2.3/4-in. The types of thimbles specified are: Ordinary, 5/16-in. to 2¼-in.; Reeving, 5/8-in. to 1½-in.; Solid, 5/16-in. to 2½-in.

An appendix to the standard gives a recommended method of making a wire rope thimble splice. Dimensional tables for each type of thimble are shown in conjunction with fully annotated diagrams.

B.S.716 "Rigging screws and stretching screws for general engineering purposes." This 30-page standard specifies materials, components, dimensions, finishing requirements and tests for rigging screws and stretching screws of nominal size 1/2-in. to 2.1/4-in. and 1/4-in. to 2-in. respectively.

All dimensional tables are presented in conjunction with fully annotated diagrams. An appendix to the publication provides the form of words for a certificate of test.

B.S.1290 "Wire rope slings and sling legs." This 51-page standard specifies dimensions, construction, loading and marking and test requirements for one-, two-, three and four leg-slings with legs of the following types: Single part sliced; double part sliced endless; and double part grommet. The slings are for use with wire ropes of 5/16-in. to 1.3/4-in. nominal diameter.

The first and second of the standard's three appendices provide a form of warranty and information on safe working loads respectively. The third appendix provides appropriate tables and figures from relevant British Standards. There are ten diagrams.

Copies of these standards may be obtained from the British Standards Institution, 2, Park Street, London, W.1. Prices: B.S.461, 5s.; B.S.462, 4s. 6d.; B.S.463, 5s.; B.S.464, 5s.; B.S.716, 7s. 6d.; B.S. 1290, 10s. Postage extra to non-subscribers.

Manufacturers' Announcements

Locomotive Ordered for the P.L.A.

Yorkshire Engine Company, Limited, Sheffield, a branch of The United Steel Companies, Limited, have been awarded a contract worth £350,000 for the supply of sixteen diesel-electric shunting locomotives to the Port of London Authority. The first of the new locomotives is due for delivery in April, 1959. This order follows the success of six Yorkshire Engine diesel-electric locomotives which have been operating at Tilbury docks for the past year.

Some of the locomotives now to be supplied will be twin-engined 400 h.p. units similar to those at Tilbury and the others will be powered by single 300 h.p. engines. The engines are manufactured by Rolls Royce Ltd. and the electrical equipment will be supplied by The British Thomson-Houston Company Ltd.

The locomotives will be engaged on heavy shunting duties and are particularly suitable for this type of work because of their safety in operation and good visibility from the driver's cab.

The British Straddle Carrier Mark II

The British Straddle Carrier Mark II, which was recently demonstrated for the first time, is claimed to be the fastest and cheapest method of transporting long and heavy loads over considerable distances and rough ground. It is the only straddle carrier produced in Britain and is the first vehicle of its type designed to comply with the "Construction and Use" regulations of the Ministry of Transport, which permits its use on public roads.

Built by the British Straddle Carrier Co., Ltd., which, as recently announced, is now a subsidiary of Short Brothers and Harland, Ltd., production is under control of the general engineering division of the Company at Newtownards, Co. Down.

The Mark II carrying a load of timber.

The Mark II embodies features which make it particularly suitable for handling rail, road, dock and airport freight, timber, steel, brick loads, pipe runs, heavy steel plate loads, oil drum cylinders and many types of loads outside the range of present handling equipment.

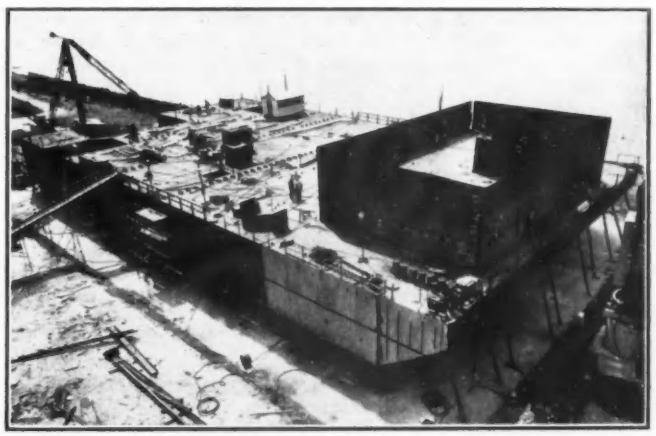
The vehicle carries its load lengthwise, and as it needs only bare clearance for its width, it can operate at speed in narrow gangways or lanes closed to vehicles which lift their loads crosswise. Features which distinguished it from the earlier model are: hydraulically operated self-aligning load hooks, four-wheel power steering, with steering lock for road use, and equal wheel size all round. The new model has a speed of 12 m.p.h. at its maximum capacity of 20,000 lbs. and with the load reduced to 14,000 lbs. the speed is raised to 30 m.p.h.

The usual system of operation is for loads to be stored and handled on bolsters or pallets. The carrier drives endwise over the load and the ledges of its lifting hooks clamp under the load, which is then raised and clamped in the transporting position under the superstructure, with the weight evenly distributed over the four wheels.

Mobile Oil Drilling Platform

The first mobile oil drilling platform to be manufactured in the United Kingdom has recently been launched at Southampton. It has been constructed by Steel Structures, Ltd., one of the Howard Group of Companies and the contract, which is worth nearly £1 million, was placed last November by the Delong Corporation of the United States.

The platform, for which 3,000 tons of steel has been used, is 190-ft. long by 106-ft. wide and 16-ft. deep. It is completely self-contained with air-conditioned accommodation for a drill crew of thirty men, and it is provided with its own generators, drilling rig, with mud hoppers, capable of drilling down to



Mobile oil drilling platform under construction at Southampton.

15,000-ft. below the sea bed, and a helicopter platform. The hull is raised and lowered on four retractable legs, and stands clear of the sea on these legs during drilling operations. When required to move to another position, it is lowered into the sea, the legs retracted and the platform can then be towed away.

Only the third of its type to be constructed in Europe, the platform is scheduled for delivery at the end of this month to the Shell Company for use in off-shore drilling operations off the coast of Borneo. It is designed for extensive towing across the ocean and for operations in as much as 125-ft. of water.

New Ship for Continental Freight Service

The m.v. "Isle of Ely" was launched recently at the yard of the Goole Shipbuilding and Repairing Co. Ltd., Goole, Yorks. This vessel is the first of two sister ships ordered from this firm by the Eastern Region of British Railways for their Continental freight services between Harwich and Rotterdam, and Harwich and Antwerp. It has been designed to carry a full load of rail freight containers, or general cargo or, alternatively, part loads of each. Of the open deck type the vessel has a length b.p. of 226-ft., a moulded breadth of 37-ft. and a depth of 23-ft. moulded to the shelter deck.

The holds and 'tween decks can accommodate 42 of the largest "B" class railway containers. Since there is ample shore crane facilities at her scheduled terminal ports, no cargo handling gear is arranged on the ship. Hatches on both main and shelter decks have MacGregor patent watertight steel covers, while shelter-deck hatch covers are of the single pull type which can be rapidly opened or closed. Main deck covers are of the latest flush type permitting the use of fork-lift trucks. The size of hatches is such that all containers may be stowed on board either by lowering direct on to the deck or tank top or by "drifting" under that hatch coaming whilst still suspended from crane hook.

The maximum deadweight capacity on the mean load draft of 13-ft. 2-in. will be approximately 900 tons. and the total capacity of holds and hatches will be approximately 85,000 cu. ft.

Accommodation has been arranged for a crew of 22. Officers and Petty Officers are in single cabins and other members of the crew in two-berth cabins. The vessel has been designed for a service speed of 13½ knots and the navigational equipment includes radar, echo-sounding equipment, radio-telephone, etc.

Manufacturers' Announcements—continued

Diesel Hydraulic Locomotives for Sierra Leon

Hudswell, Clarke & Company Limited have received from the Crown Agents for Oversea Governments and Administrations an extension to their contract for a further eight main line diesel hydraulic locomotives for the Sierra Leone Government Railway. This addition brings the number of locomotives the company are now building for this Railway to sixteen, and the total value of the contract is approximately £500,000.

The locomotives are being fitted with a "Paxman" Hi-Dyne (Constant H.P.) diesel engine, together with a Vulcan Sinclair dual fluidrive transmission unit.

This type of locomotive has been developed by Hudswell, Clarke & Company Limited over the past four years and are known as the "Enterprise" series, according to the power ranges required.

The prototype locomotive has undergone extensive trials, and this order has resulted from its successful performance.

New Heavy-Duty Compactor

The first demonstration model of the Vibro-Tamper was recently imported to this country from the United States where it is manufactured by the International Vibration Company of Cleveland, Ohio. It has been in use in America for more than ten years.

The machine consists of a welded frame mounted on crawler tracks and carrying at the front six vibrating shoes which are attached to the frame by articulated links to allow them to follow the ground contours and so reduce to a minimum the vibration transmitted to the main frame. Each shoe has its own double vibrator unit driven from the main engine through V-belts, the vibration having a frequency of 2,000/2,200 r.p.m. with an amplitude of approximately ¼-in. This results in a downward force of 8,000/9,000 pounds over the 240 sq. inches of each shoe. The crawler tracks are driven from the 75 h.p. engine which gives the machine speeds ranging between 14-ft. a minute and 1¾ m.p.h. The width of the six shoes is 12-ft. 6-in., with two 4-in. extensions available to increase this to 13-ft. 2-in. and by removal of the two outer shoes this width may be reduced to 8-ft. 6-in. If necessary one or more of the remaining four shoes may be chained up to reduce the width still further.

The Vibro-Tamper is designed for the compaction of most types of base materials ranging from stabilised soils to quarry waste. It has been demonstrated on a variety of materials including the compaction of quarry waste, rubble, hoggin, ash, shale, wet-mix macadam and base-course tarmacadam.

It is claimed to have advantages over plate vibrators, notably its high output, ease of travelling on site, and, due to its width and steady working pace, the even and finished surface which it can produce.

The sole agents in the United Kingdom are Roadways Equipment (1938) Ltd., 232, Vauxhall Bridge Road, London, S.W.1.

APPOINTMENTS VACANT

BRITISH TRANSPORT DOCKS invite applications for appointment as ENGINEERING ASSISTANT on the staff of the Civil Engineer, South Wales Docks; salary range £943/985 per annum or above according to qualifications.

Applicants should have experience in the design and construction of general Civil Engineering Works preferably with knowledge of maritime works, but this is not essential; should be able to prepare estimates of cost and contract documents. They should be Corporate Members of the Institution of Civil Engineers or qualified for election. Certain free travel facilities, Superannuation Scheme, etc.

Applications, stating age, experience and qualifications, should be sent to the Chief Docks Manager, South Wales Docks, Pierhead Buildings, Cardiff, to arrive not later than 29th August, 1958.

WANTED

Back Numbers of "Dock and Harbour Authority."

February, May, December 1955.
March, April, May, June, July 1956.
February, March, April, August, September 1957.

If you have copies available, please write to Box 197, "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

OFFERED FOR SALE OR HIRE

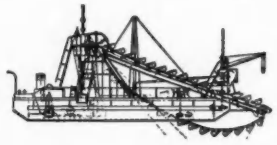
DREDGING MATERIAL

Bucket dredgers, dredgers, barges tugs, booster stations, etc.

Material in good condition and partly available at short notice.

Applications to: Box No. 212
THE DOCK & HARBOUR AUTHORITY,
19, HARCOURT STREET, LONDON, W.1

For SALE and/or CHARTER



Section built Diesel electr. CUTTER and Barge unloading SUCTION DREDGE. Built 1954 Class. Bur. Véritas. Cutter depth 16 m. Suction- and discharge 650 mm. ø Dim. 44,15 x 7,15/12 x 2,80 M. 2 Sandpumps driven by 2 x 1265/1500 h.p. Mirrlee's Diesels. 2 gen. sets of 400 and 200 h.p. for Cutter, winches and aux. Floating and shore-pipeline.

Diesel-electr. CUTTER - SUCTION DREDGE built 1954 Bur. Vér. Dim. 35 x 8 x 3 m. Cutter depth 13 m. Suction-discharge 500 mm. ø. 2 pumps driven by 2 x 500 h.p. Deutz Diesel. 2 gen. sets each 150 h.p. for Cutter motor, winches and aux. Floating and shore pipeline.

Floating Booster-Station, suction-discharge 650 mm.

Pontoon 28 x 5 x 1,85 m. Pump-engine 900 h.p. Diesel.

HOPPER-BARGES 60, 100, 160 and 300 m.3 Hopper capacity.

Fa. HENDRIK BOOGAARD - SLIEDRECHT - HOLLAND

Postbox 40. Cables: DRAGOB. Tel. 45 and 769.

Sworn Brokers for Dredging and Floating Equipment.

CRANDALL

Dry Dock Engineers, Inc.

238 Main Street
Cambridge 42, Massachusetts
U.S.A.

RAILWAY DRY DOCKS	Structural Design
FLOATING DRY DOCKS	Supervision
BASIN DRY DOCKS	Underwater Examination
PIERS	Cost Estimates
RETAINING WALLS	Appraisals
PORT FACILITIES	Surveys & Reports

Cable Address: "CRADOC, Boston"

PROGRESS...

The result of never being satisfied